Missouri Department of Transportation

Bridge Division

Bridge Design Manual

Section 3.30

Revised 04/04/2005

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DEAD LOAD TO GIRDERS FOR STANDARD SLAB ON PRESTRESS OR STEEL GIRDERS
(3" P/C PANELS OR C.I.P.)

ROADWAY	NO. OF GDRS.	LOAD EQUAL TO ALL GIRDERS (DLII) (LBS./FT.)		LOAD TO EACH GIRDER (DLI) (LBS./FT.)		
		SAFETY BARRIER CURB (1)	F.W.S. (2)	SLAB ONLY (*) (WEIGHT OF HAUNCH NOT INCLUDED)		
				EXT. GDR.	INT. GDR.	CL. GDR.
26'-0"	4	171	228	728	796	_ _ _
28'-0"	4	171	245	749	881	_ _ _
30'-0"	4	171	263	805	932	_ _ _
32'-0"	4	171	280	860	983	_ _ _
36'-0"	5	137	252	735	892	856
38'-0" (Unsymm.)	5	137	266	752	958	903
40'-0"	5	137	280	815	981	945
44'-0"	5	137	308	918	1047	1031

(1) Safety Barrier Curb load is for a 16" curb, curb height = 2'-8".

(2) For F.W.S. = 35 lbs per sq. ft.

(*) Slab weight is for an 8-1/2" slab thickness.
Haunch weight and additional slab weight due to P/S panels with uniform joint filler is not included.

DEAD LOAD TO GIRDERS FOR S.I.P. FORMS ON CURVED STEEL GIRDERS

ROADWAY	NO. OF GDRS.	LOAD EQUAL TO ALL GIRDERS (DLII) (LBS./FT.)		LOAD TO EACH GIRDER (DLI) (LBS./FT.)		
		SAFETY BARRIER CURB (1)	F.W.S. (2)	SLAB ONLY (*) (WEIGHT OF HAUNCH NOT INCLUDED)		
				EXT. GDR.	INT. GDR.	CL. GDR.
26'-0"	4	171	228	775	925	_ _ _
28'-0"	4	171	245	800	1021	_ _ _
30'-0"	4	171	263	859	1081	_ _ _
32'-0"	4	171	280	917	1140	_ _ _
36'-0"	5	137	252	786	1038	975
38'-0" (Unsymm.)	5	137	266	805	1113	1029
40'-0"	5	137	280	870	1142	1075
44'-0"	5	137	308	978	1221	1173

(1) Safety Barrier Curb load is for a 16" curb, curb height = 2'-8".

(2) For F.W.S. = 35 lbs per sq. ft.

(*) Slab weight is for an 8-1/2" cantilever slab thickness and a slab thickness between the girders = 8-1/2"+1-1/4"= 9-3/4". (Slab is adjusted for a 2-1/2" corragated S.I.P. form)

DESIGN CRITERIA: SLABS ON GIRDERS (AASHTO Art. 3.24)

Stresses
fc = 1600 psi, f'c = 4000 psi, n = 8, fy = 60,000 psi

Moments Over Interior Support (Use for positive moment reinf. also)
(Sec. 1.5 E40A)

Dead Load = $-0.107wS^2$ (Continuous over 5 supports)
Dead Load = $-0.100wS^2$ (Continuous over 4 supports)

Live Load = (S + 2)P/32 Continuity Factor = 0.8 (AASHTO Art. 3.24.3)
Impact Factor = 1.3
P = 16 Kips for HS20
P = 20 Kips for HS20 Modified

Design Load
$M_U = 1.3(M_{DL} + 1.67M_{LL+I})$

Cantilever Moment (AASHTO Art. 3.24.5)

Dead Load = Moment due to slab, F.W.S. and S.B.C.

Live Load
Wheel Load = M_{LL+I} = Px/E Where: P = Wheel load (apply impact factor)
x = Dist. from load to support (ft.)
E = 0.8x + 3.75

Collision Load = M_{COLL} = Py/E Where: P = 10 kips (Collision force)
y = Moment arm (Curb ht.+ 1/2 Slab th.)
E = 0.8x + 5.0

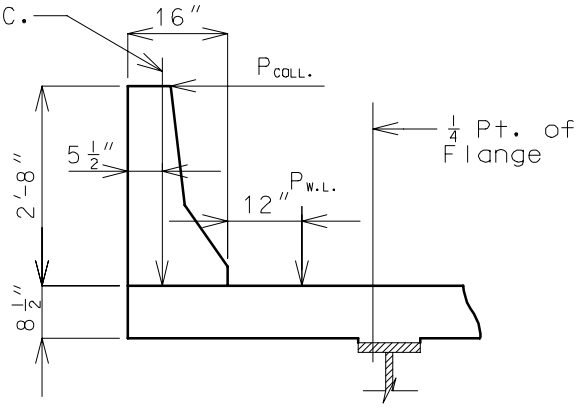
Where: x = Dist. from C.G. of S.B.C. to support

The "support" is assumed at the $\frac{1}{4}$ pt. of the minimum flange.

Wheel loads and collision loads shall not be applied simultaneously.

Use the greater of the two for the Design Load.

Design Load
$M_U = 1.3(M_{DL} + 1.67M_{LL+I})$



SLAB CANTILEVER SECTION

Design of top reinf. is based on maximum moment over supports or cantilever moment. Flexural reinforcement shall meet the criteria of AASHTO Art. 8.16.3.

When designing for bottom transverse reinforcement, a 1" wearing surface is removed from the effective depth.

Prestressed panels replace the bottom transverse reinforcement.

Prestressed panels are assumed to carry DL1 stresses. Therefore, the negative moment due to DL1 at interior supports may be neglected.

The maximum P/S panel width (clear span + 6") for HS20 Modified is 9'-6". (Based on 10'-0" girder spacing and 10" flanges)
The maximum P/S panel width (clear span + 6") for HS20 is 9'-11".

For concrete slab resisting moment see page 1.5-1 and 1.5-2 of this section.

DESIGN CRITERIA: DISTRIBUTION OF FLEXURAL REINFORCEMENT (AASHTO Art. 8.16.8.4)

Allowable Stress:

$$F_s = \frac{Z}{(d_c \times A)^{1/3}} \leq 0.6 f_y$$

Where:

z = 130 k/in.

d_c = Dist. from extreme tension fiber to center of closest bar (concrete cover shall not be taken greater than 2″)

A = Effective tension area of concrete = $2 d_c s$

s = Bar spacing ctr. to ctr.

Actual Stress:

$$f_s = \frac{M_w}{A_s \times j \times d}$$

Where:

Mw = Service load moment
As = Area of steel
$j = 1 - k/3$

$$k = \sqrt{2n\rho + (n\rho)^2} - n\rho$$

$n = E_S / E_C$

$\rho = A_s/(b \times d)$

b = Effective width
d = Effective depth

Distribution of flexural reinforcement does not need to be checked in concrete considered unexposed to weather.

Longitudinal distribution reinforcement:

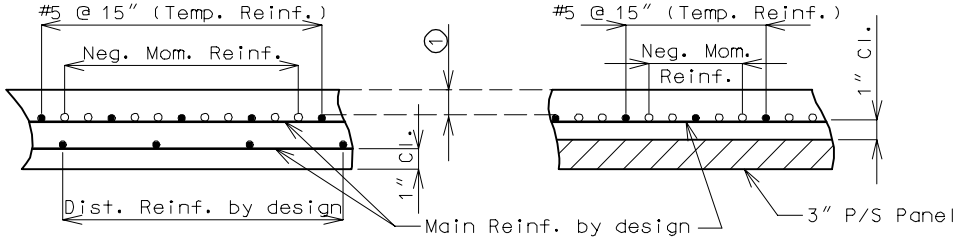
Top of slab - use #5 bars at 15″ cts. for temperature distribution.
Bottom of slab - by design. (AASHTO Art. 3.24.10)

Negative moment reinforcement over supports:

Steel structures - add. #6 bars at 5″ between #5 bars. (AASHTO Art. 10.38.4)
P/S girder structures - by design, see Sec. 3.55.

Additional reinforcement over supports shall be a minimum of #5 bars and a maximum of #8 bars at 5″ ctrs. When necessary, replace the #5 temperature reinforcement with a larger bar to satisfy negative moment reinforcement requirement, but keep all bars within two bar sizes.

Note: See Sec. 2.4 page 12-1 for details of negative moment reinforcement.



① 3″ Cl. preferred min., 2-3/4″ Cl. preferred min. for P/S panels to accommodate #8 bars over supports and 2-1/2″ Cl. absolute min. by AASHTO 8.22.1.

Method of measurement:
The area of the concrete slab shall be measured and computed to the nearest square yard. This area shall be measured transversely from out to out of slab and longitudinally from end to end of bridge slab.

DESIGN CRITERIA

PRECAST PRESTRESSED PANELS

3" Precast prestressed concrete panels with 5-1/2" minimum cast-in-place concrete will be the standard slab used on all girder superstructures except curved steel structures. Panel details are shown on page 1.2-3 to 1.2-6 of this section.

Concrete for prestressed panels shall be Class A1 with f'c = 6,000 psi, f'ci = 3,500 psi. Prestressing tendons shall be uncoated, low-relaxation, seven-wire(7) strands for prestressed concrete conforming to AASHTO M203 Grade 270, with nominal diameter of strand = 3/8" and area = 0.085 sq.in., minimum ultimate strength = 22.95 kips (270 ksi), and strand spacing = 4.5 inches.

Panels shall be set on joint filler in accordance with Section 1057.2.5 of Mo Std. Spec. or polystyrene bedding material. Filler thickness shall be a Min. of 3/4" and a Max. of 2". Standard filler width is 1-1/2" except at splice plates where 3/4" Min. is allowed to clear splice bolts. Joint filler thickness may be reduced to a minimum of 1/4" over splice plates on steel structures. For prestressed girder structures, joint filler thickness may be varied within these limits to offset girder camber or at the contractor's option a uniform 3/4" (Min.) thickness may be used throughout. The same thickness shall be used under any one edge of any panel and the maximum change in thickness between adjacent panels shall be 1/4".

Standard roadway cross sections and slab reinforcement for HS20 and HS20 Modified live loads are shown on page 1.4-2 to page 1.4-10 of this section. Reinforcement shown is for a cast-in-place slab or a P/S panel slab with the bottom layer of reinforcement between girders being replaced by the panels. Cantilever reinforcement details for P/S panel slab are shown on page 1.2-3 and 1.2-5 of this section.

Maximum panel width (clear span + 6") = 9'-6" for HS20 Modified.
Maximum panel width (clear span + 6") = 9'-11" for HS20.

When a safety barrier curb or median barrier curb is permanently required on the structure, other than at the edge of slab, precast prestressed panels will not be allowed in the bay underneath the curb. P/S panels are not allowed for use as simply supported for live loads, i.e. staging, where only two supports may be provided for live loads.

S.I.P.

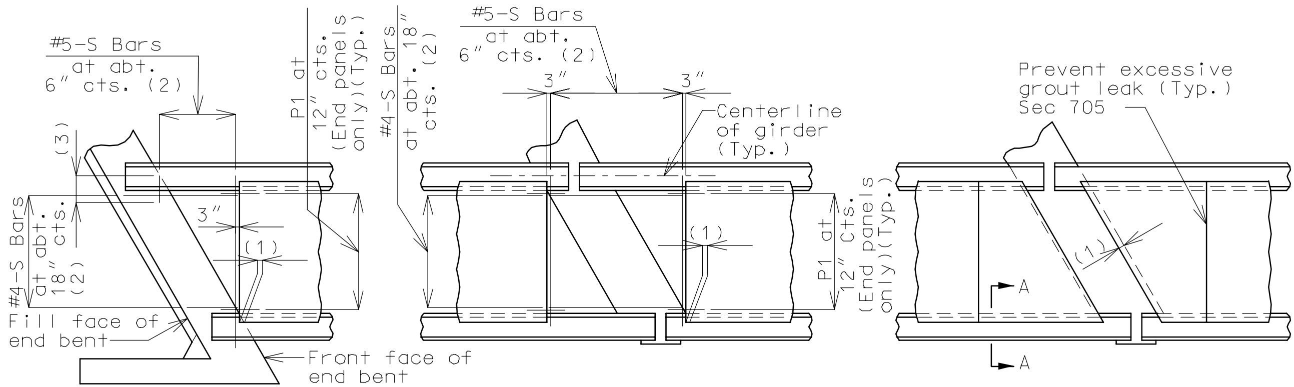
Stay-in-place corrugated metal forms with cast-in-place concrete may be used on horizontally curved steel structures with the approval of the Structural Project Manager.

The standard slab reinforcements shown on page 1.4-2 to page 1.4-10 of this section for HS20 live load were designed using S.I.P. Dead Loads. If design is for HS20 Modified, the standard slab reinforcement needs to be checked for S.I.P. forms.

The bottom transverse reinforcement shall maintain a 1" clear distance from the top of forms.

C.I.P.

8-1/2" cast-in-place concrete slab with conventional forming may be used at the contractor's option, on all girder structures. Conventional forming shall also be used between girders with stage construction joints.



PANELS-SQUARED ENDS

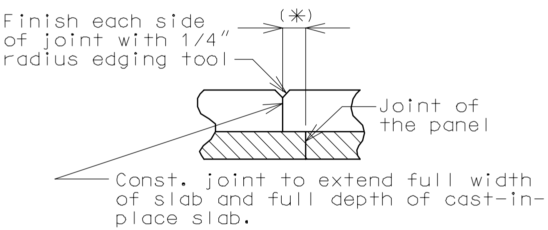
PANELS-SKEWED ENDS

PLAN OF PRECAST PRESTRESSED PANELS PLACEMENT

(1) End panels shall be dimensioned 1" min. to 1-1/2" max. from the inside face of diaphragm.

(2) S-Bars shown are bottom steel in slab between panels and used with squared end panels only.

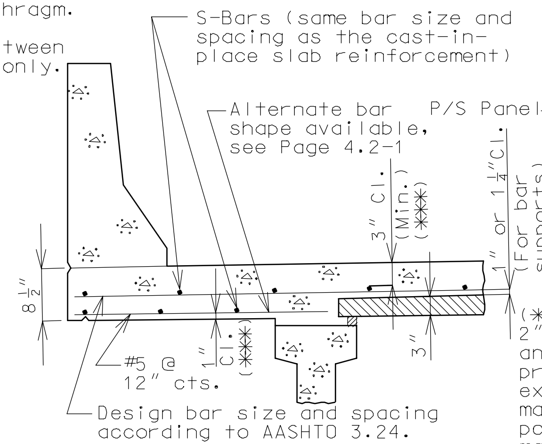
(3) Extend S-Bars 18 inches beyond the front face of end bents only.



SECTION THRU CONST. JOINT

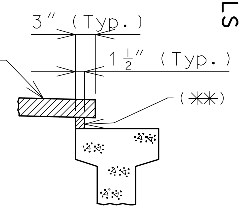
(*) Adjust the permissible construction joint to a clearance of 6 inches minimum from the joints of the panels.

Note: All reinforcement other than prestressing strands shall be epoxy coated.



(***) See Section 2.4 page 10-2 of this manual.

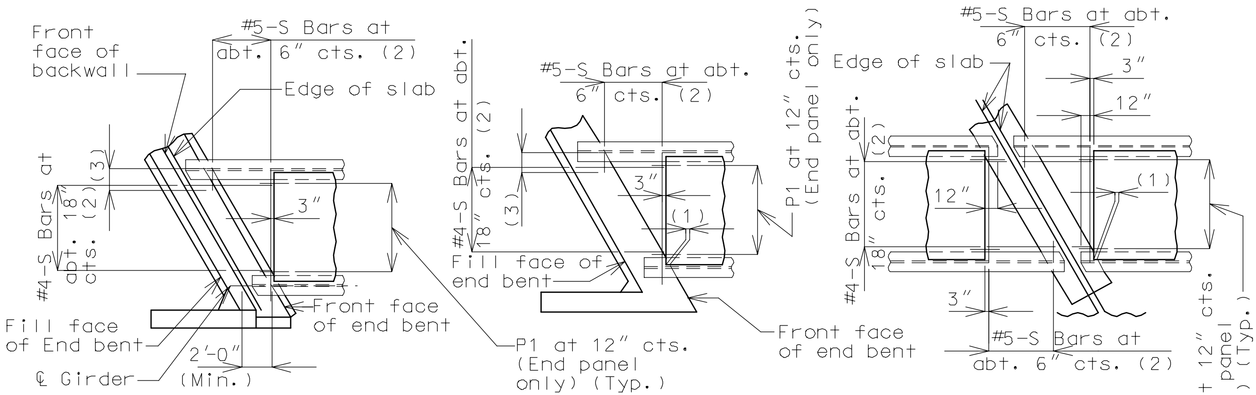
SECTION THRU CANTILEVER



SECTION A-A

(**) 3/4" Min. thru 2" max. thickness and 1-1/2" width of preformed fiber expansion joint material Sec 1057 or polystyrene bedding material Sec 1073.

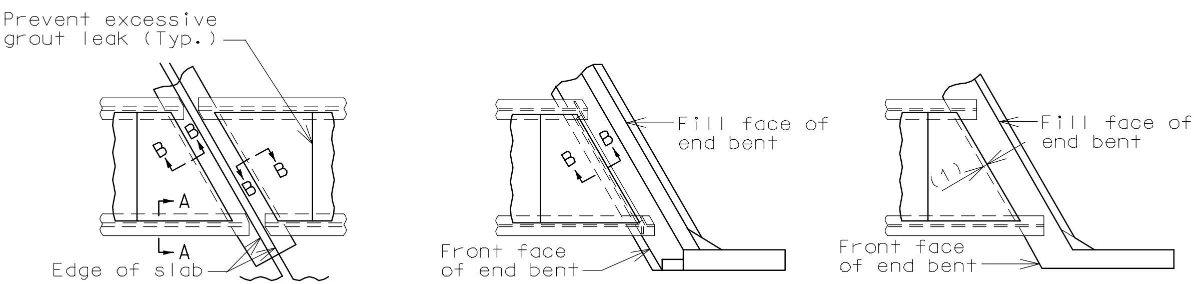
DETAILS OF PRECAST PRESTRESSED PANELS STEEL STRUCTURE



END BENT — END BENT (INTEGRAL) — INT. BENT (EXP. GAP)

PANELS-SQUARED ENDS

(1) End panels shall be dimensioned 1" min. to 1-1/2" max. from the inside face of diaphragm.
(2) S-Bars shown are bottom steel in slab between panels and used with squared end panels only.
(3) Extend S-bars 18 inches beyond the front face of end bents only.



INT. BENT (EXP. GAP) — END BENT — END BENT (INTEGRAL)

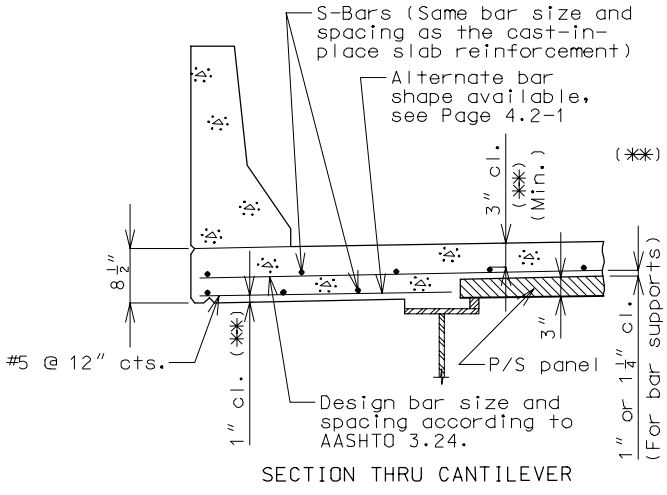
PANELS-SKEWED ENDS

Note: For details of section A-A & B-B, see Sec. 3.30 page 1.2-5.

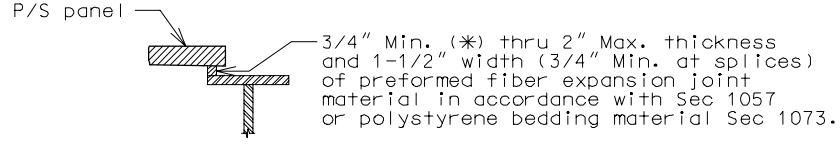
PLAN OF PRECAST PRESTRESSED PANELS PLACEMENT

DETAILS OF PRECAST PRESTRESSED PANELS
STEEL STRUCTURE (CONT.)

Note: All reinforcement other than prestressing strands shall be epoxy coated.

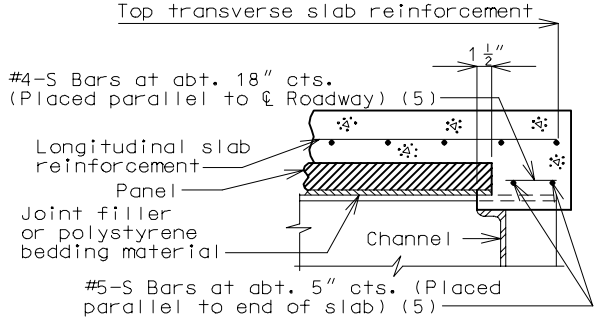


SECTION THRU CANTILEVER



SECTION A-A

(*) Over splice plates, Min. thickness will be 1/4".

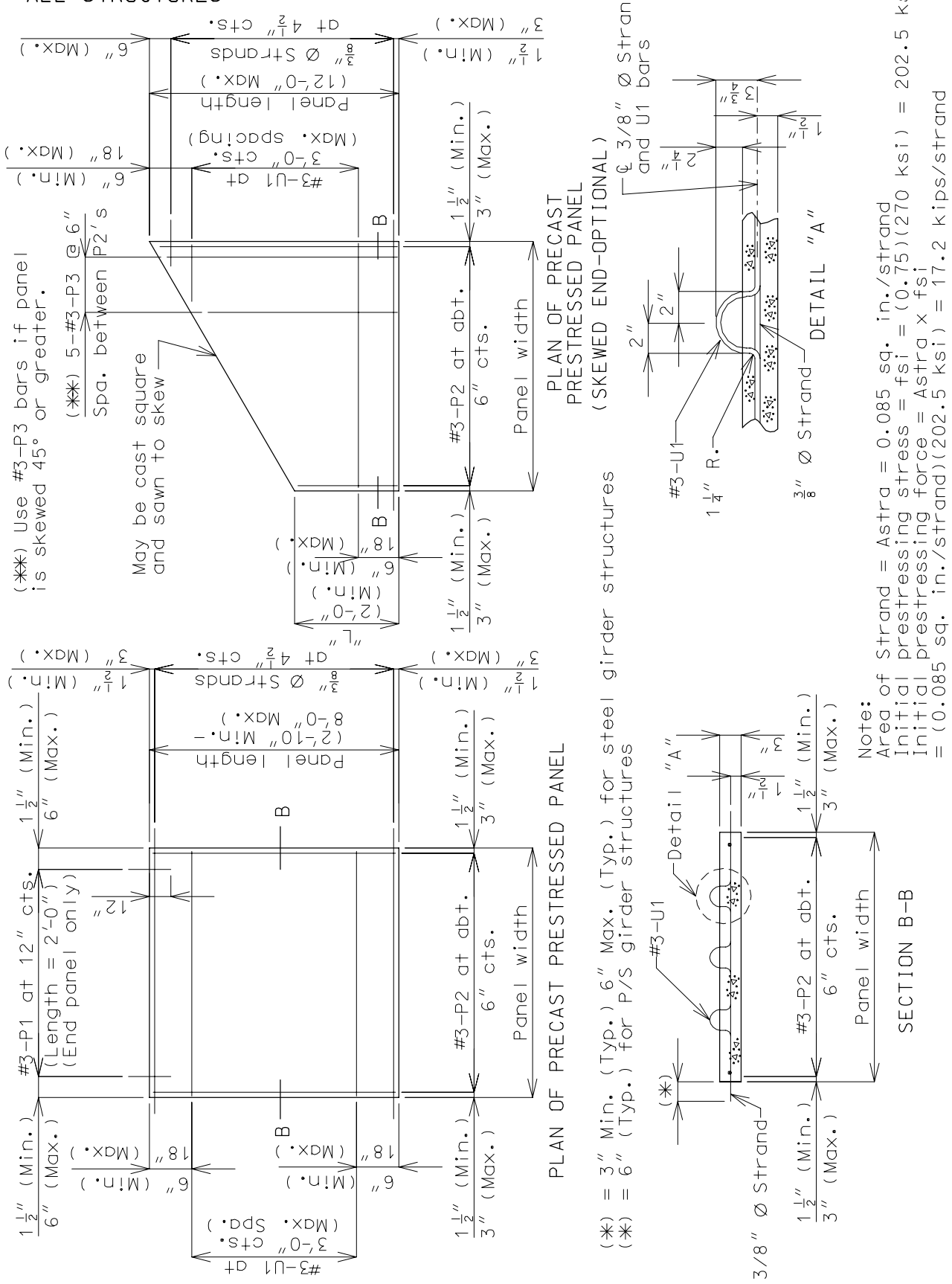


PART SECTION B-B

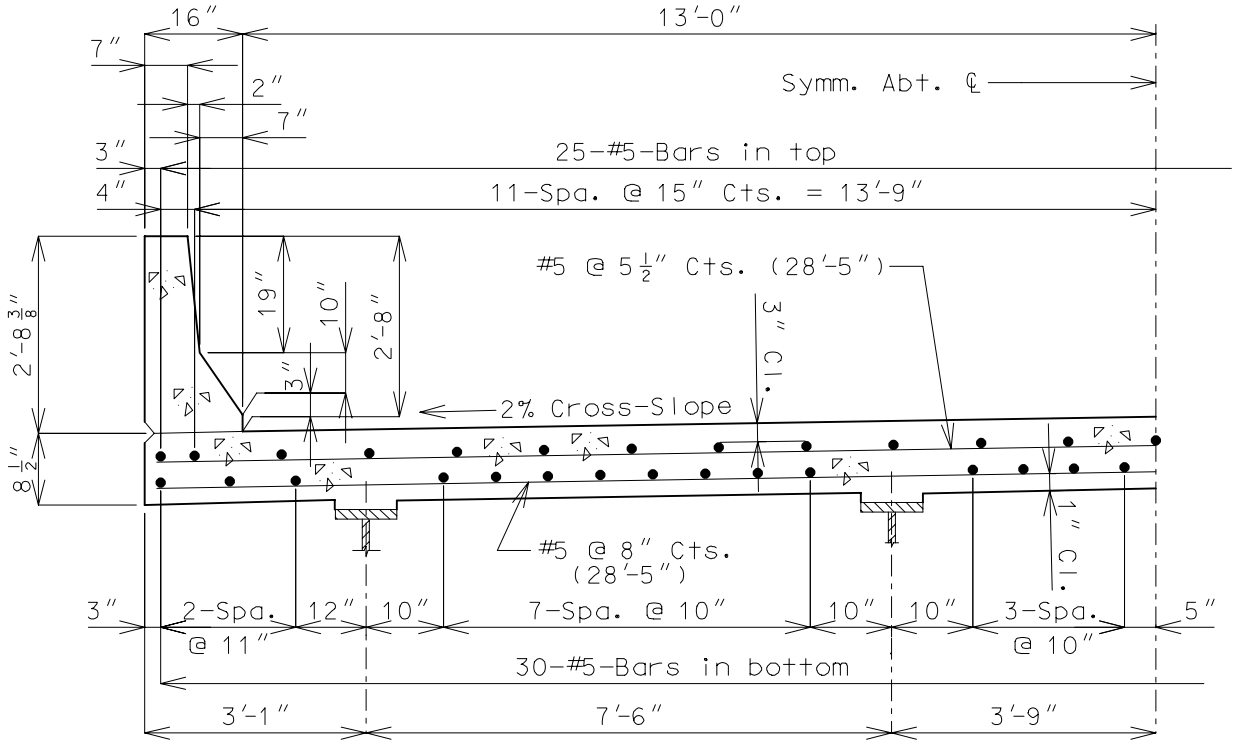
(5) S-Bars shown are used with skewed end panels, or square end panels of square structures only. The #5-S Bars will extend the width of slab (30" lap if necessary) or to within 3" of expansion device assemblies.

Note: For location of section A-A & B-B, see Sec. 3.30 Page 1.2-4.

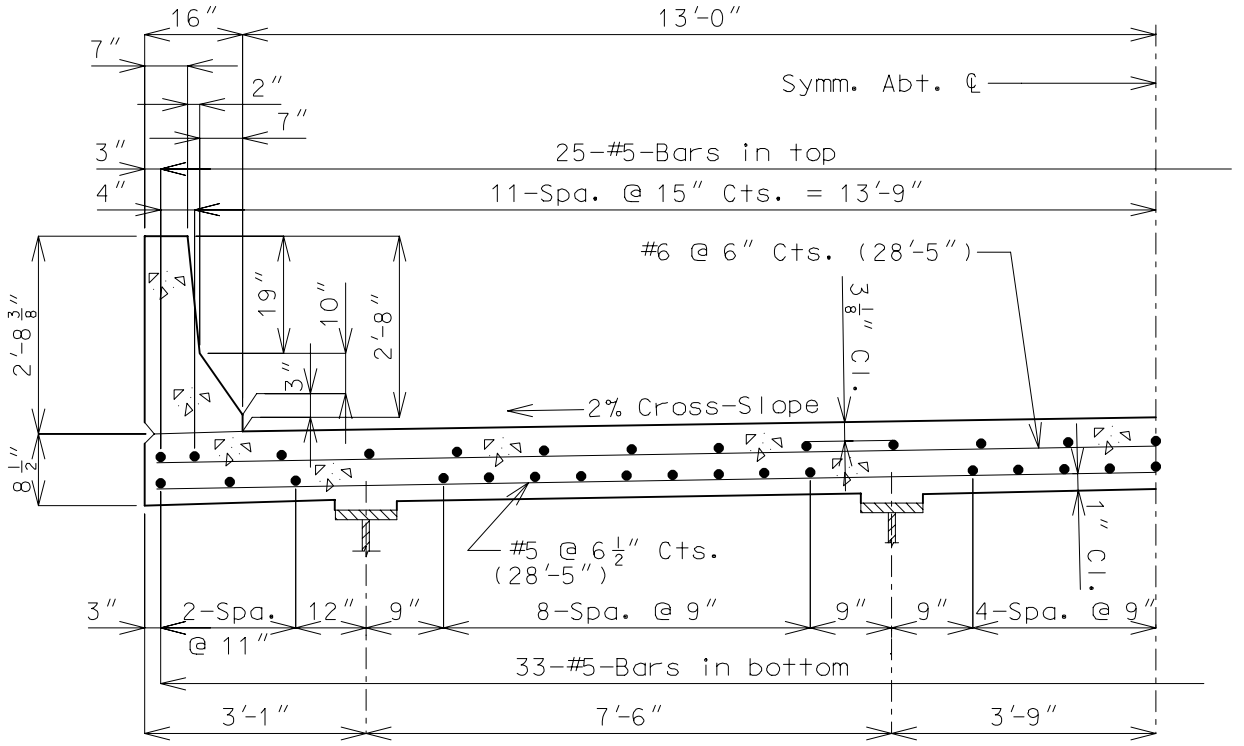
DETAILS OF PRECAST PRESTRESSED PANELS ALL STRUCTURES



DETAILS OF CONCRETE SLABS FOR STRUCTURES (CONT.) Concrete Slab



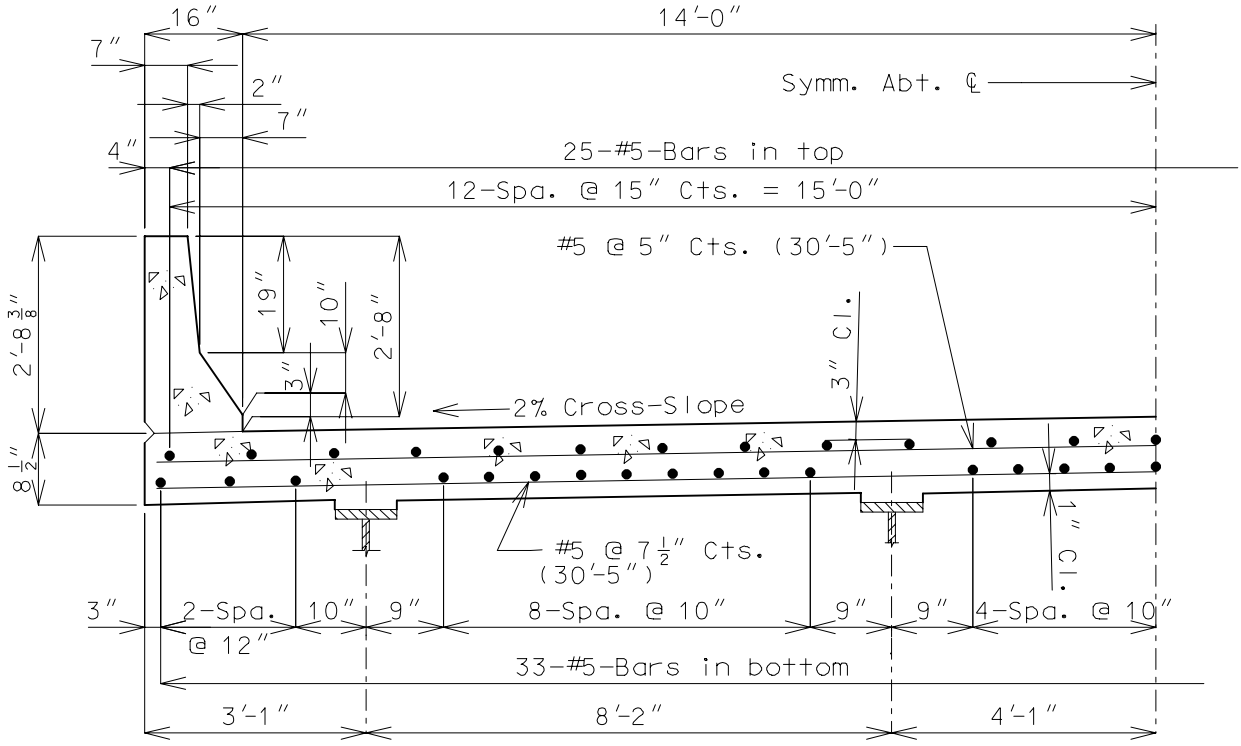
HS20 (26′-0″ ROADWAY - 4 GIRDER)



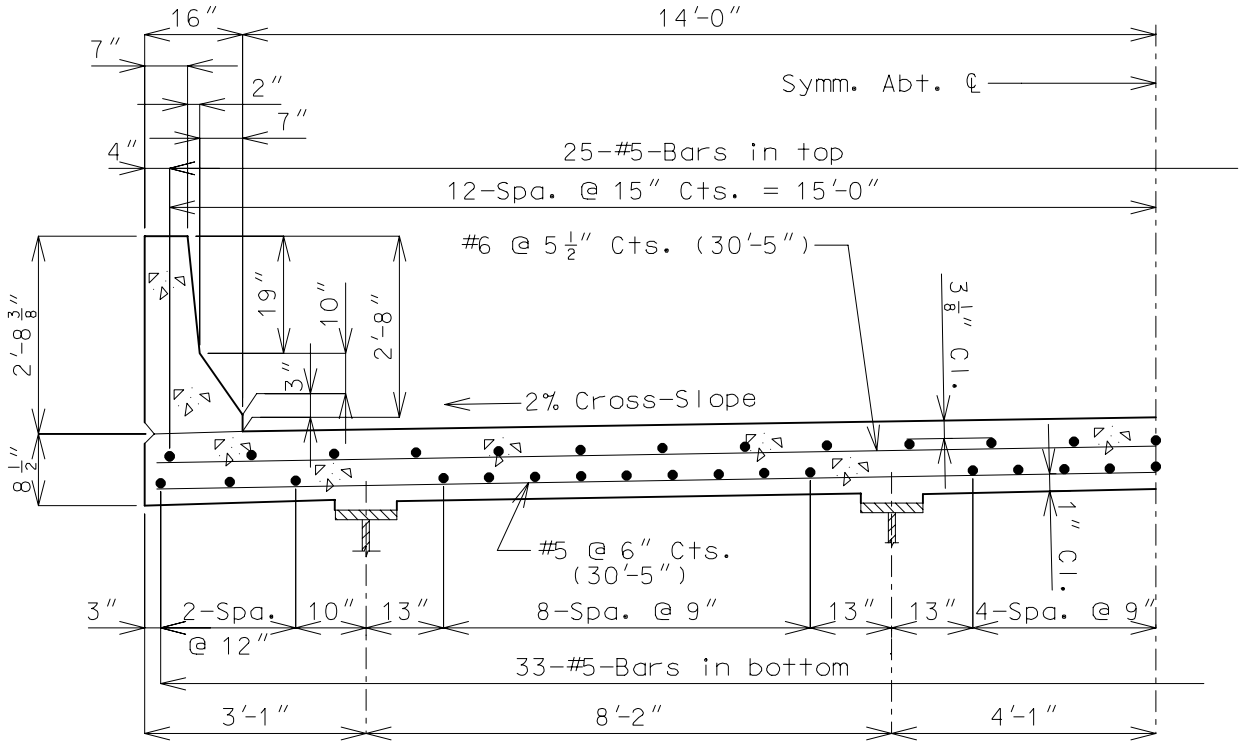
HS20 MODIFIED (26′-0″ ROADWAY - 4 GIRDER)

NOTE: SEE PAGE 1.4-1 OF SECTION 3.30 FOR NOTES.

DETAILS OF CONCRETE SLABS FOR STRUCTURES (CONT.) Concrete Slab



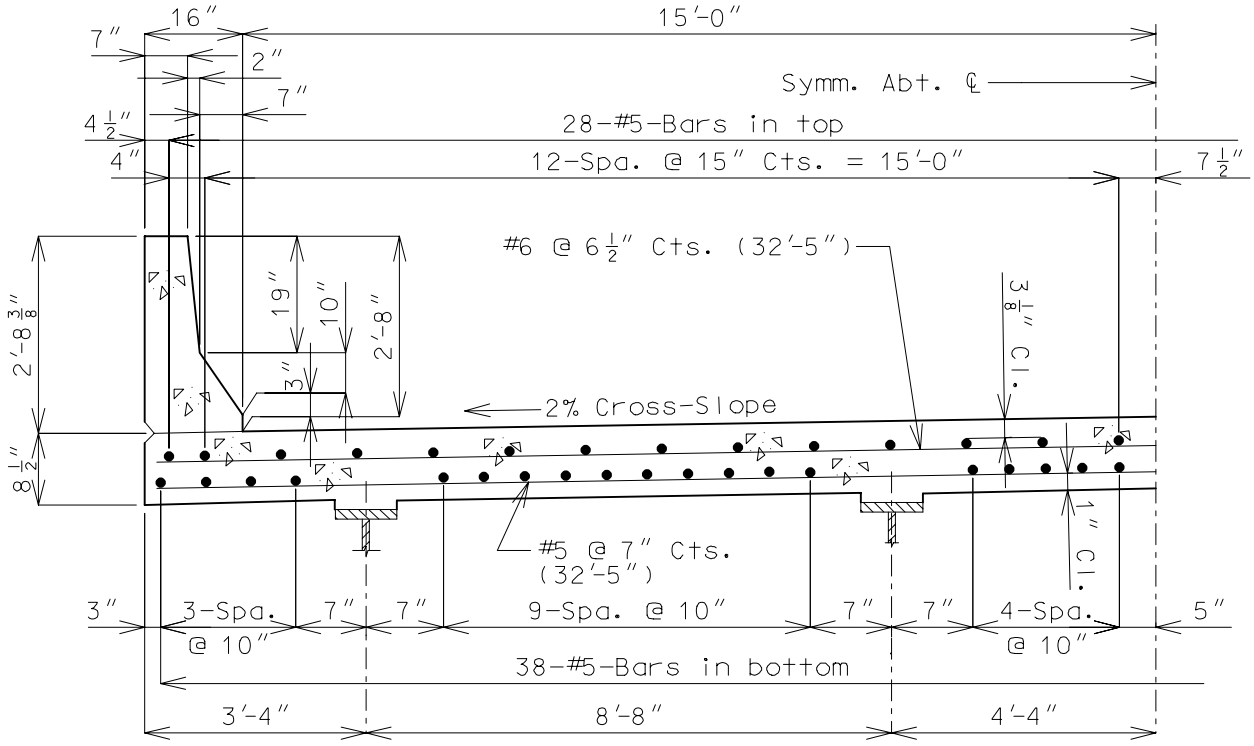
HS20 (28′-0″ ROADWAY - 4 GIRDER)



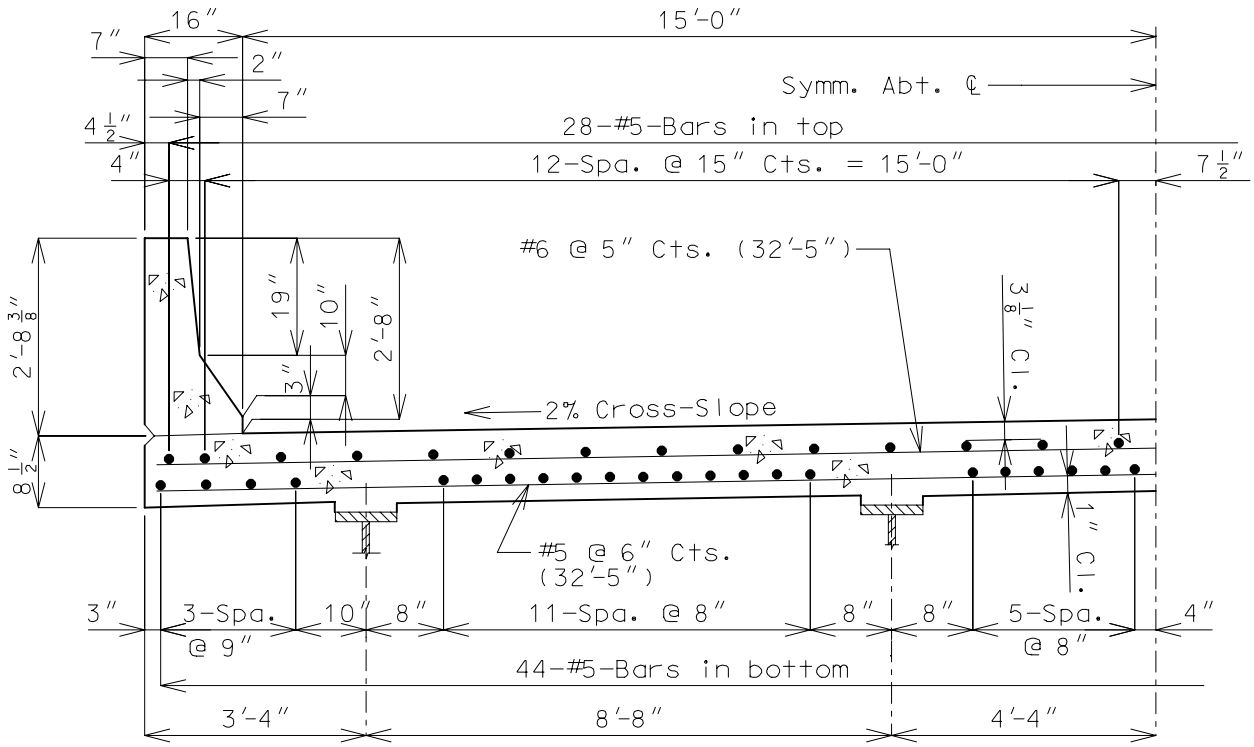
HS20 MODIFIED (28′-0″ ROADWAY - 4 GIRDER)

NOTE: SEE PAGE 1.4-1 OF SECTION 3.30 FOR NOTES.

DETAILS OF CONCRETE SLABS FOR STRUCTURES (CONT.) Concrete Slab



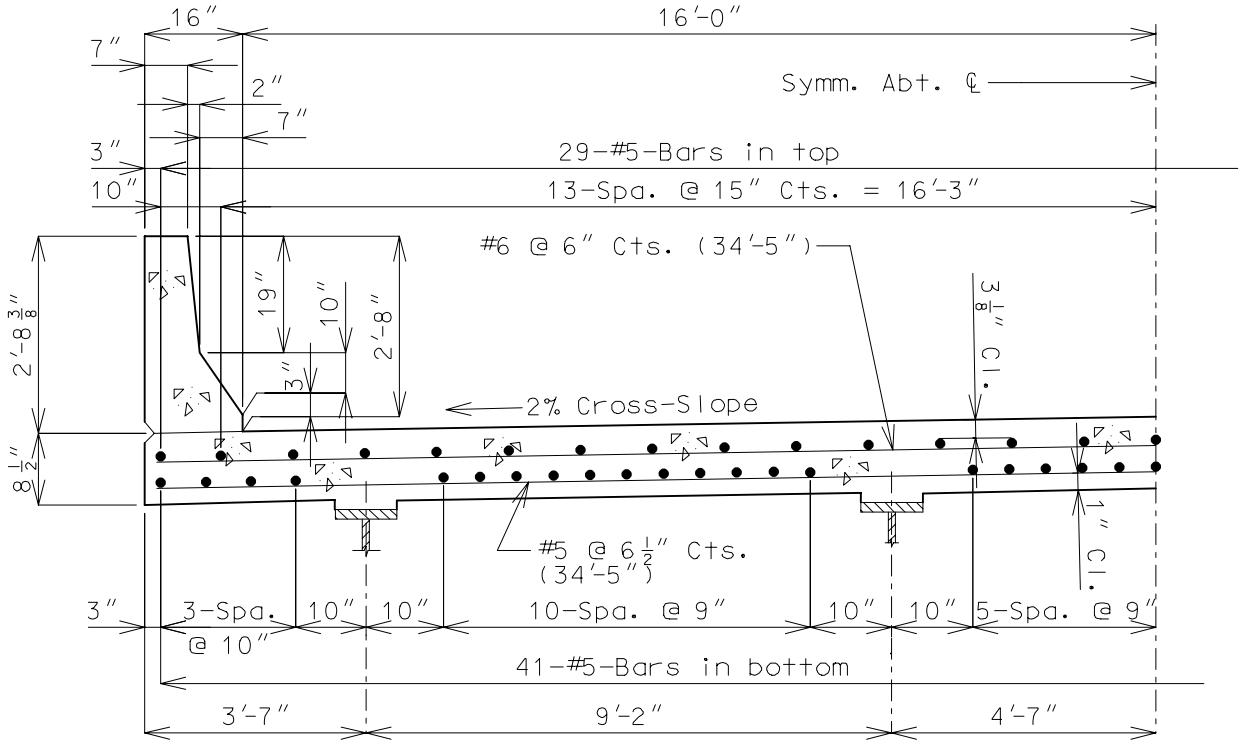
HS20 (30′-0″ ROADWAY - 4 GIRDER)



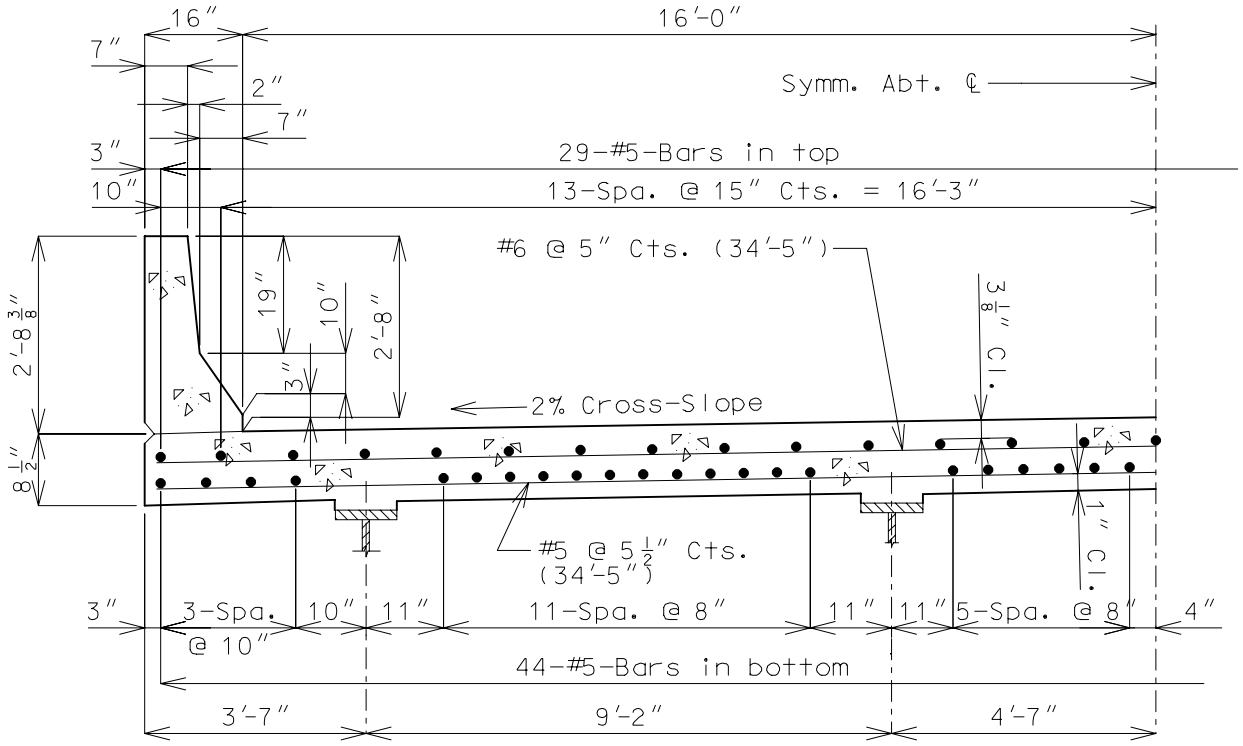
HS20 MODIFIED (30′-0″ ROADWAY - 4 GIRDER)

NOTE: SEE PAGE 1.4-1 OF SECTION 3.30 FOR NOTES.

DETAILS OF CONCRETE SLABS FOR STRUCTURES (CONT.) Concrete Slab



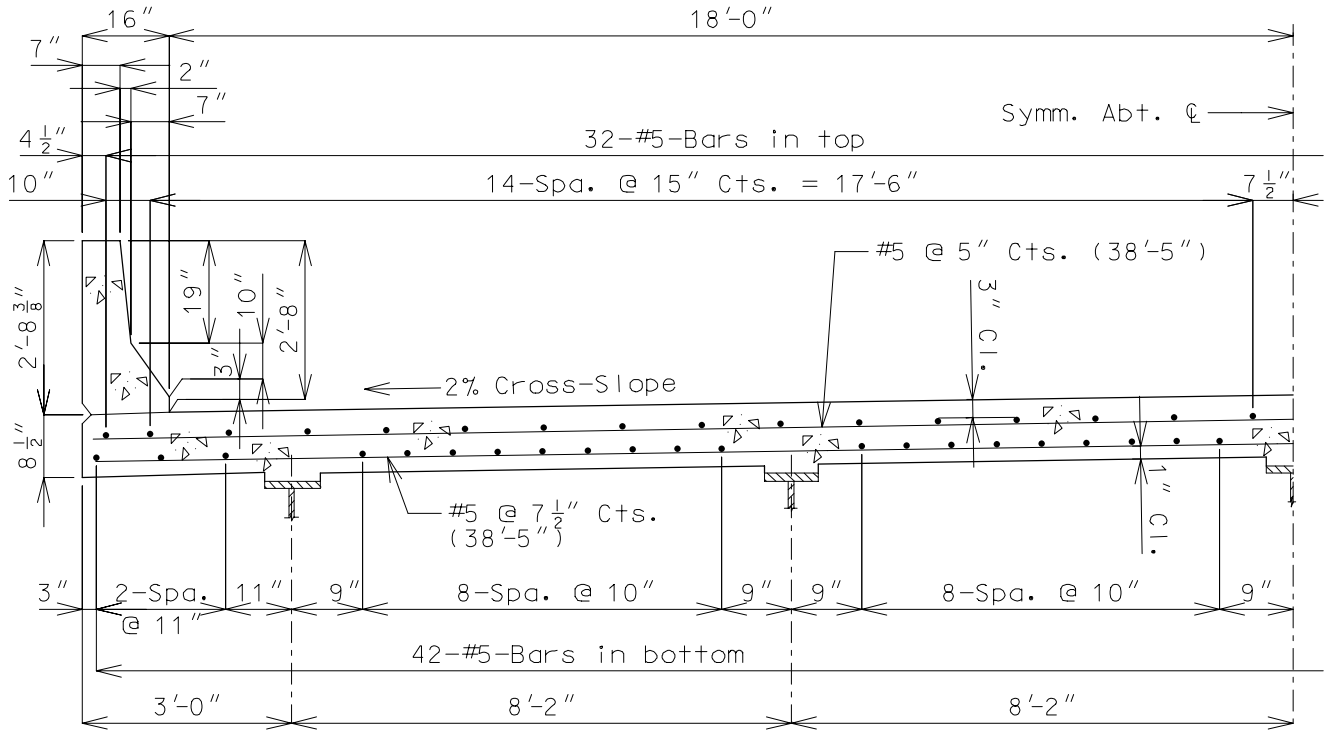
HS20 (32′-0″ ROADWAY - 4 GIRDER)



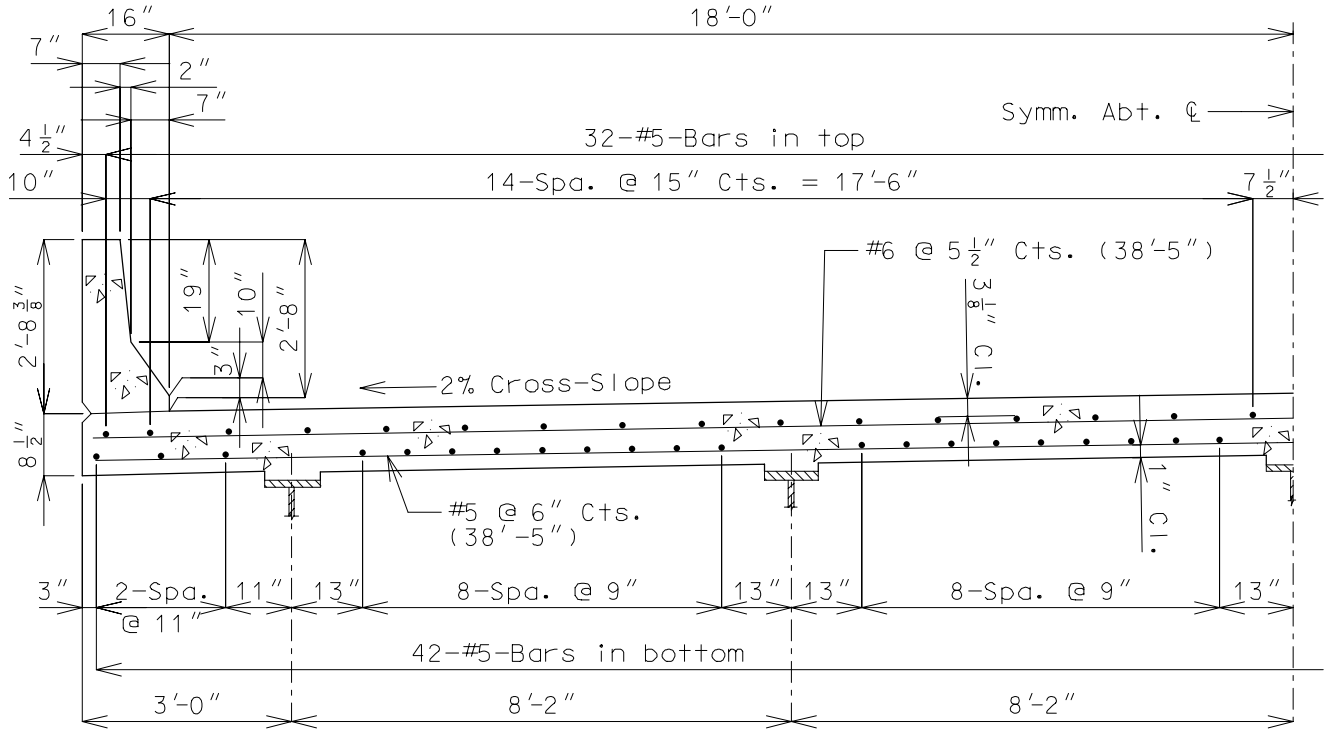
HS20 MODIFIED (32′-0″ ROADWAY - 4 GIRDER)

NOTE: SEE PAGE 1.4-1 OF SECTION 3.30 FOR NOTES.

DETAILS OF CONCRETE SLABS FOR STRUCTURES (CONT.) Concrete Slab



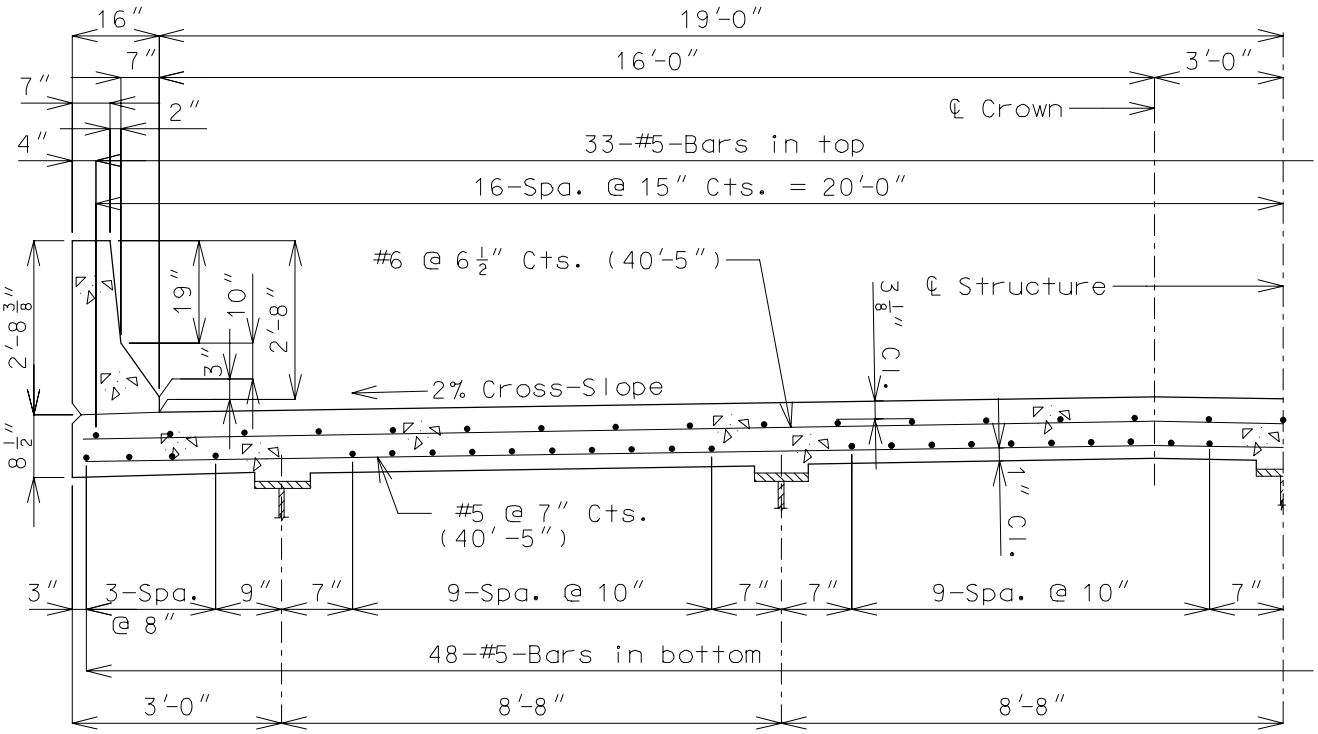
HS20 (36′-0″ ROADWAY - 5 GIRDER)



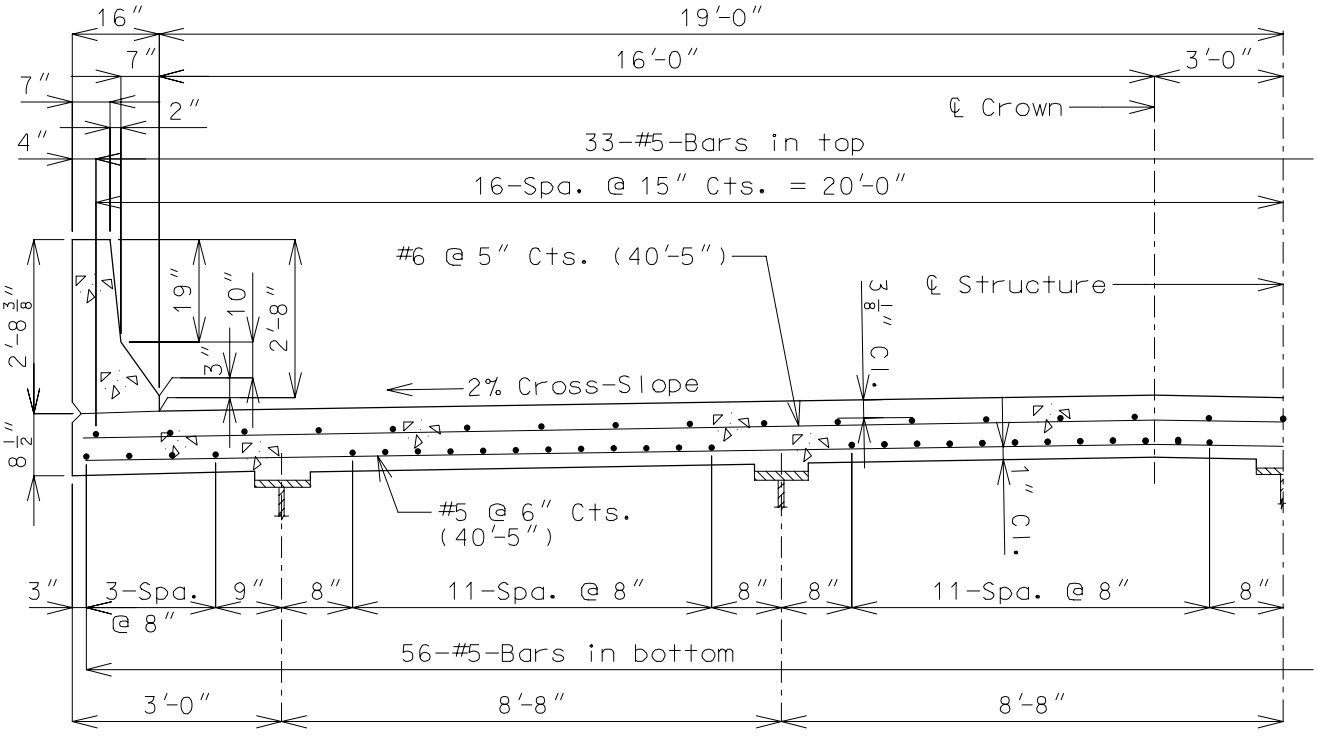
HS20 MODIFIED (36′-0″ ROADWAY - 5 GIRDER)

NOTE: SEE PAGE 1.4-1 OF SECTION 3.30 FOR NOTES.

DETAILS OF CONCRETE SLABS FOR STRUCTURES (CONT.) Concrete Slab

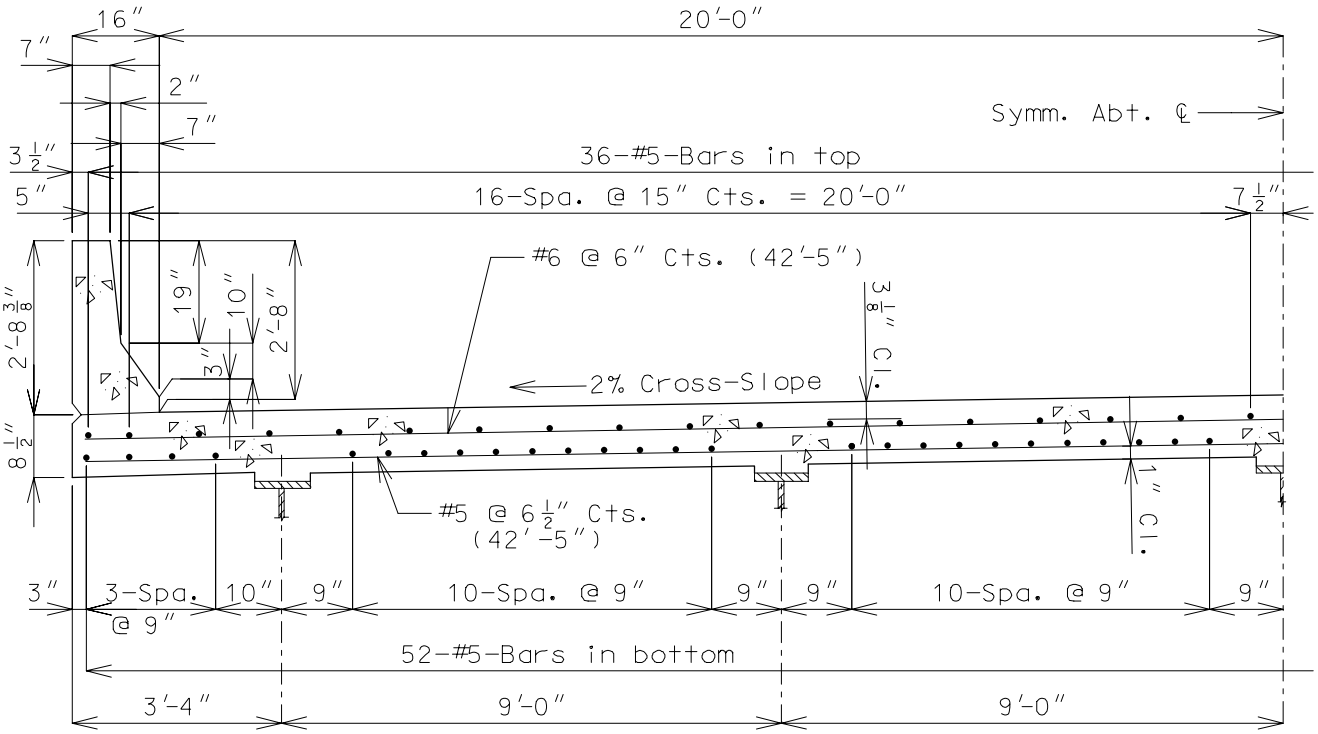


HS20 (38′-0″ ROADWAY - 5 GIRDER) (UNSYMMETRICAL)

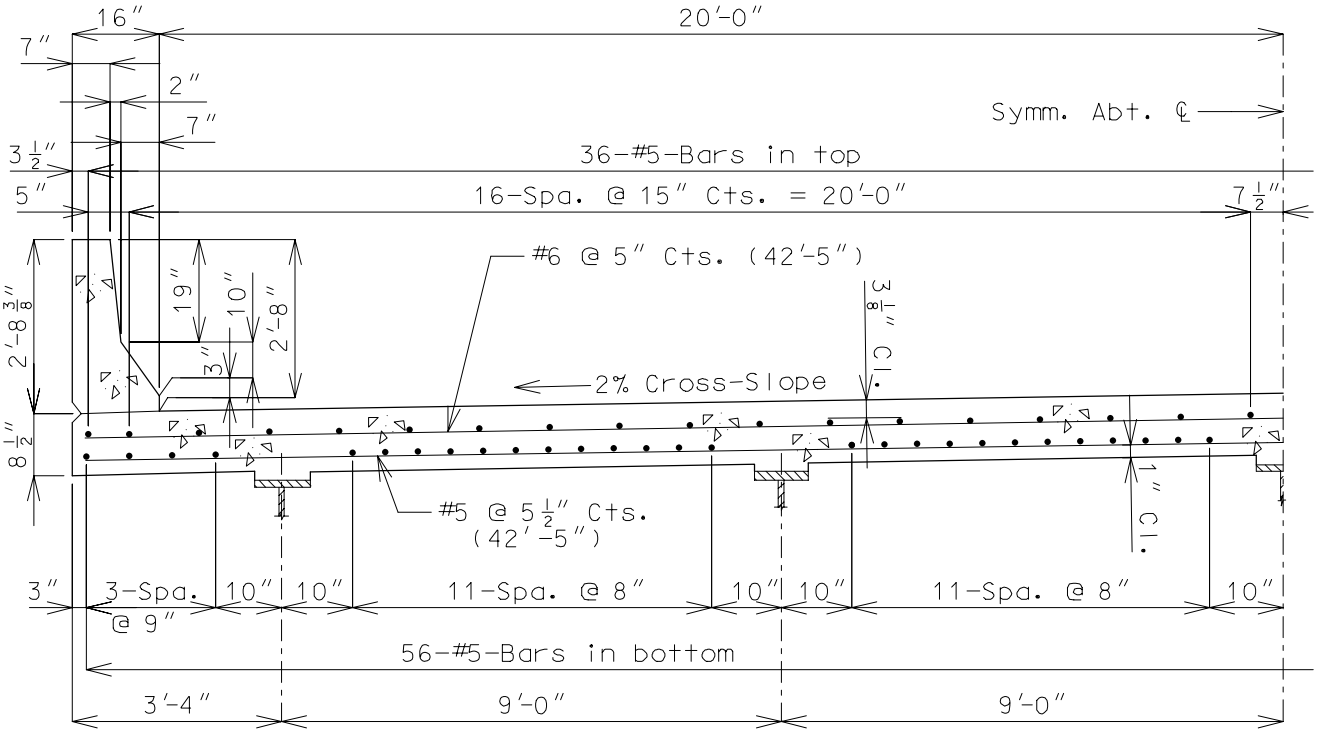


HS20 MODIFIED (38′-0″ ROADWAY - 5 GIRDER) (UNSYMMETRICAL)

NOTE: SEE PAGE 1.4-1 OF SECTION 3.30 FOR NOTES.



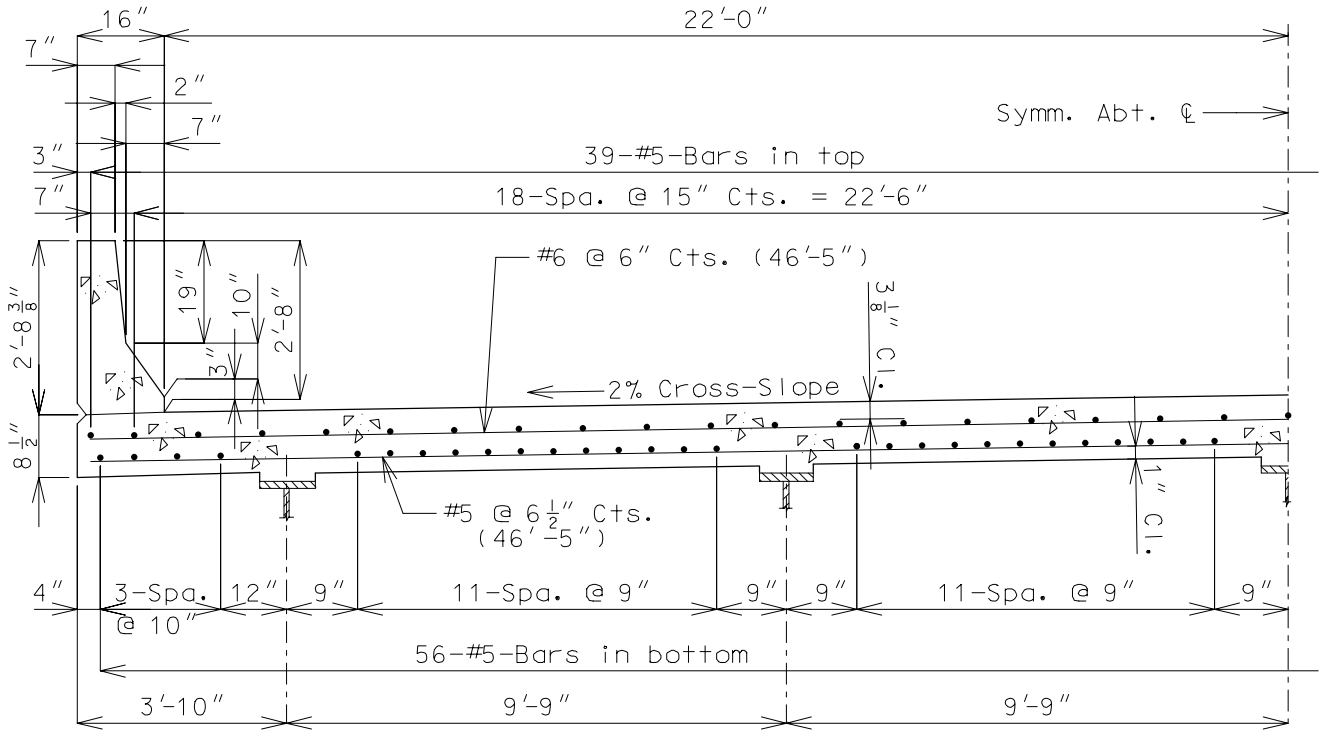
HS20 (40′-0″ ROADWAY - 5 GIRDER)



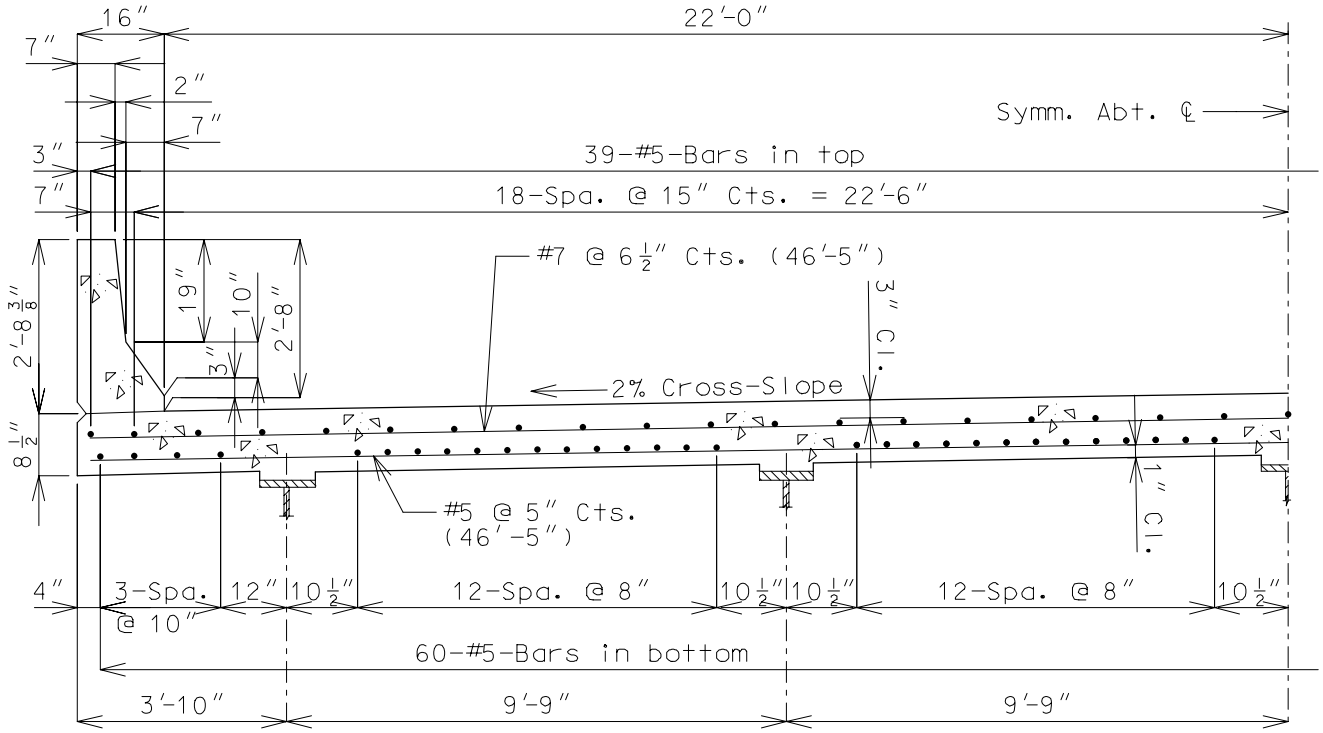
HS20 MODIFIED (40′-0″ ROADWAY - 5 GIRDER)

NOTE: SEE PAGE 1.4-1 OF SECTION 3.30 FOR NOTES.

DETAILS OF CONCRETE SLABS FOR STRUCTURES (CONT.) Concrete Slab



HS20 (44′-0″ ROADWAY - 5 GIRDER)

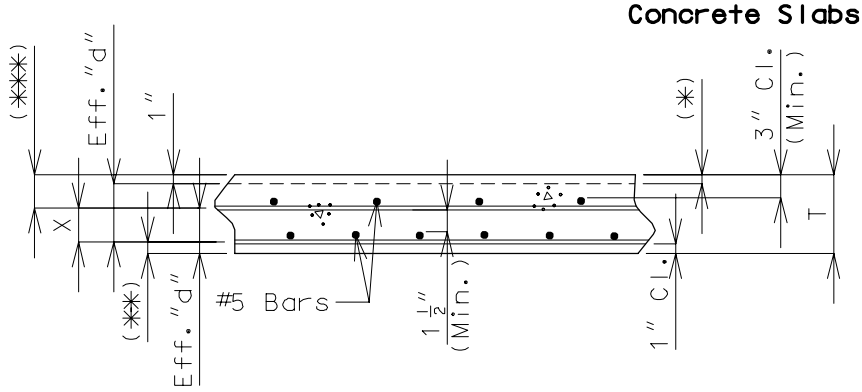


HS20 MODIFIED (44′-0″ ROADWAY - 5 GIRDER)

NOTE: SEE PAGE 1.4-1 OF SECTION 3.30 FOR NOTES.

RESISTING MOMENTS

Based on
fy = 60,000 psi
f'c = 4,000 psi
n = 8



(*) For slabs without Asphaltic Concrete Protective Wearing Surface neglect 1" Monolithic Concrete Wearing Surface.

(**) 1-5/16" for #5
1-3/8" for #6

(***) 3-15/16" for #5
4-1/8" for #6

Ultimate Strength Design, Ø = 0.90 (Top Reinforcement)

NEGATIVE MOMENT REINFORCEMENT:					
T	Eff. "d"	X	Reinforcement	As(in^2/ft.)	ØMn (lbs.-ft.)
8 ½"	4 9/16"	3 ¼"	#5 @ 7"	0.526	9884
8 ½"	4 9/16"	3 ¼"	#5 @ 6 ½"	0.566	10561
8 ½"	4 9/16"	3 ¼"	#5 @ 6"	0.614	11359
8 ½"	4 9/16"	3 ¼"	#5 @ 5 ½"	0.669	12255
8 ½"	4 9/16"	3 ¼"	#5 @ 5"	0.739	13319
8 ½"	4 3/8"	3"	#6 @ 7"	0.757	13009
8 ½"	4 3/8"	3"	#6 @ 6 ½"	0.816	13862
8 ½"	4 3/8"	3"	#6 @ 6"	0.884	14818
8 ½"	4 3/8"	3"	#6 @ 5 ½"	0.964	15904
8 ½"	4 3/8"	3"	#6 @ 5"	1.060	17151

RESISTING MOMENTS (CONT.)

Ultimate Strength Design, Ø = 0.90 (Top Reinforcement)

POSITIVE MOMENT REINFORCEMENT:					
T	Eff. "d"	X	Reinforcement	As(in^2/ft.)	ØMn (lbs.-ft.)
8 1/2"	6 3/16"	3 1/4"	#5 @ 9"	0.409	10835
8 1/2"	6 3/16"	3 1/4"	#5 @ 8 1/2"	0.433	11436
8 1/2"	6 3/16"	3 1/4"	#5 @ 8"	0.460	12108
8 1/2"	6 3/16"	3 1/4"	#5 @ 7 1/2"	0.491	12874
8 1/2"	6 3/16"	3 1/4"	#5 @ 7"	0.526	13730
8 1/2"	6 3/16"	3 1/4"	#5 @ 6 1/2"	0.566	14700
8 1/2"	6 3/16"	3 1/4"	#5 @ 6"	0.614	15849
8 1/2"	6 3/16"	3 1/4"	#5 @ 5 1/2"	0.669	17147
8 1/2"	6 3/16"	3 1/4"	#5 @ 5"	0.739	18701
8 1/2"	6 1/8"	3"	#6 @ 9"	0.589	15087
8 1/2"	6 1/8"	3"	#6 @ 8 1/2"	0.624	15911
8 1/2"	6 1/8"	3"	#6 @ 8"	0.663	16820
8 1/2"	6 1/8"	3"	#6 @ 7 1/2"	0.707	17833
8 1/2"	6 1/8"	3"	#6 @ 7"	0.757	18969

In general, the 5″ depth (concrete filled to half depth) steel grid bridge flooring shall be specified. Bar spacing may vary as necessary to meet minimum section modulus requirements. Main member spacing shall not exceed 10″ and cross bar spacing shall not exceed 4″. At present, the manufacturers of the following types have provided data to show they are acceptable:

Greulich 5″ Standard

Foster 5″ Standard

The section properties (n = 8) and maximum span for HS20 loading have been computed for these types and are as follows:

Company	(For Design Purpose only) Weight (PSF) (Steel & Conc.)	Main bar Spacing	Cross bar Spacing	Moment of Inertia ($in.^4/Ft.$)		
				Mid Span		Over-Support
				Conc.	Steel	Steel
Greulich	48.0	$7\frac{1}{2}$″	$3\frac{3}{4}$″	99.41	12.43	9.03
Foster	48.0	8″	4″	128.1	16.01	12.25

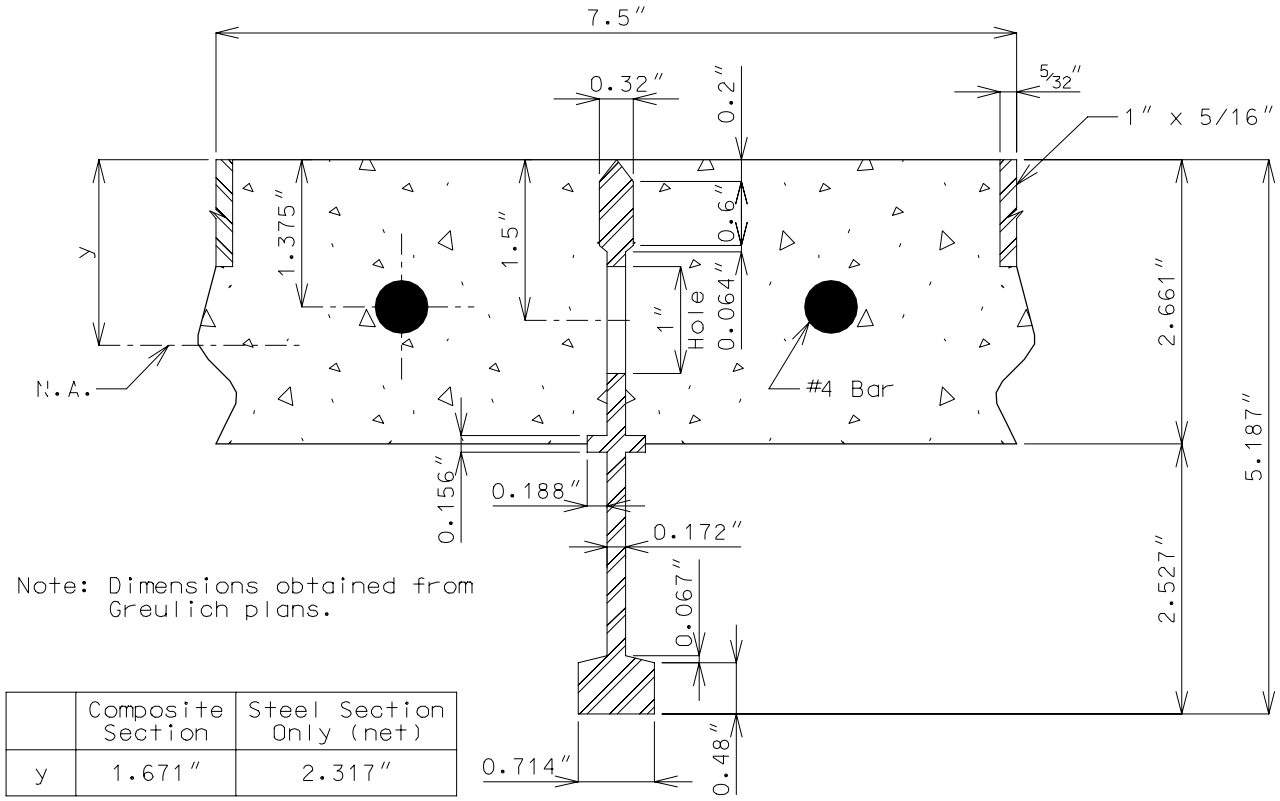
Company	Section Modulus ($in.^3/Ft.$)				Maximum Span (✳)			
	Mid-Span		Over-Support		Simple Span		Continuous Spans	
	Conc. (Top)	Steel (Bott.)	Steel (Top)	Steel (Bott.)	ASTM A709 Gr.36	ASTM A709 Gr.50W	ASTM A709 Gr.36	ASTM A709 Gr.50W
Greulich	59.5	3.53	3.90	3.14	4′-4″	5′-10″	5′-10″	7′-1″
Foster	72.5	4.68	5.24	4.30	5′-9″	7′-5″	7′-2″	9′-4″

The cross-section DETAILS used in computing the section properties are shown on the sketches on the following sheets. Maximum span determination included an allowance for a 35#/sq.ft. future wearing surface and assumed a wheel load to be distributed, normal to the main bars, over a width of 4′-0″.

(Place the following note on the Bridge Plans with the Steel Grid Details.

Note: The steel grid deck shall be electrically grounded.

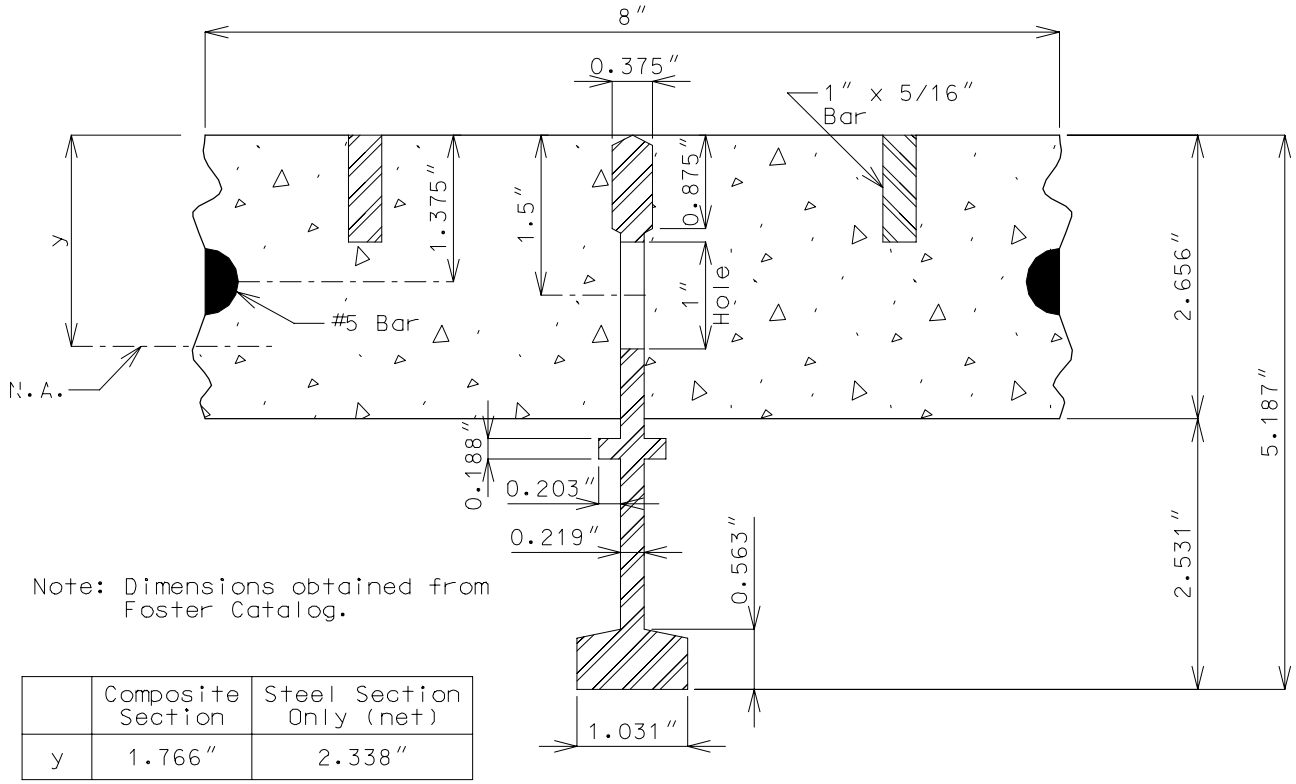
(✳) For main beams of grid either parallel or perpendicular to traffic.



Note: Dimensions obtained from Greulich plans.

	Composite Section	Steel Section Only (net)
y	1.671″	2.317″

GREULICH 5″ STANDARD

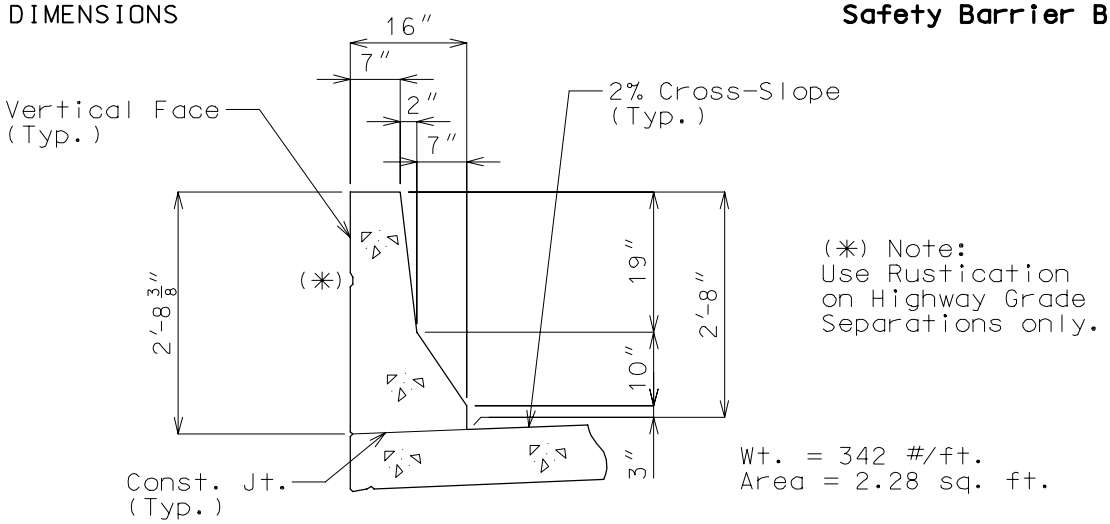


Note: Dimensions obtained from Foster Catalog.

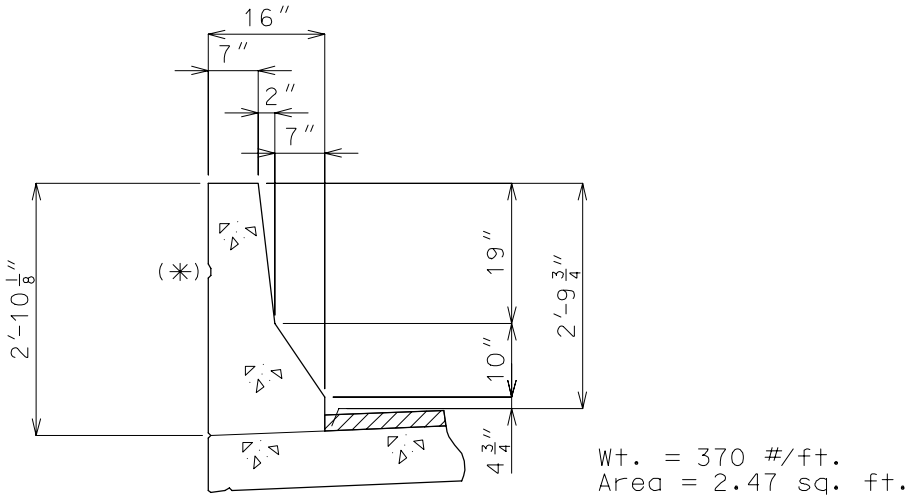
	Composite Section	Steel Section Only (net)
y	1.766″	2.338″

FOSTER 5″ STANDARD

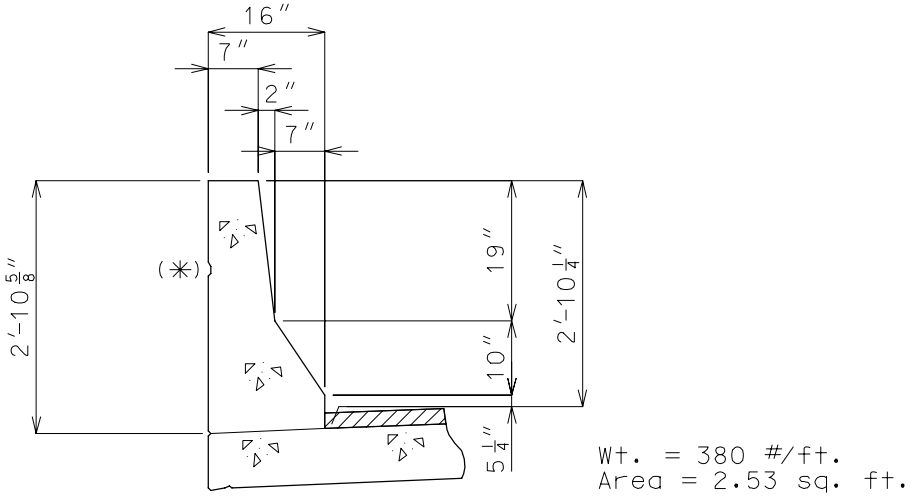
DIMENSIONS **Safety Barrier Bridge Curb**



NO WEARING SURFACE



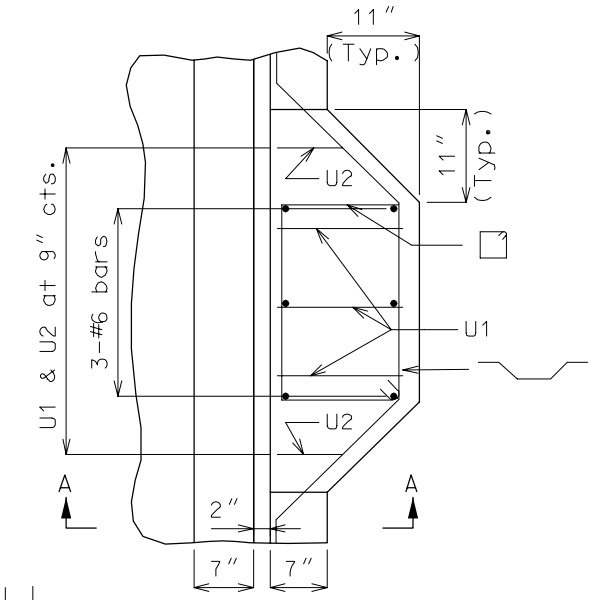
1-3/4″ WEARING SURFACE



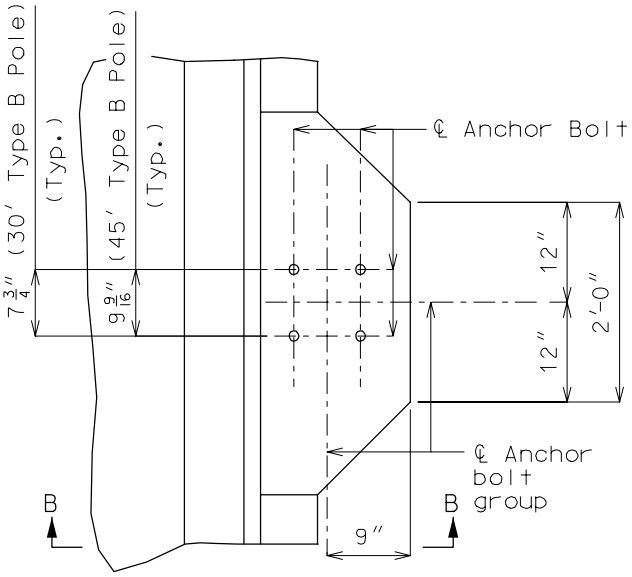
2-1/4″ WEARING SURFACE

DETAILS OF MOUNTING LIGHT POLES ON CURB (16" SAFETY BARRIER CURB)

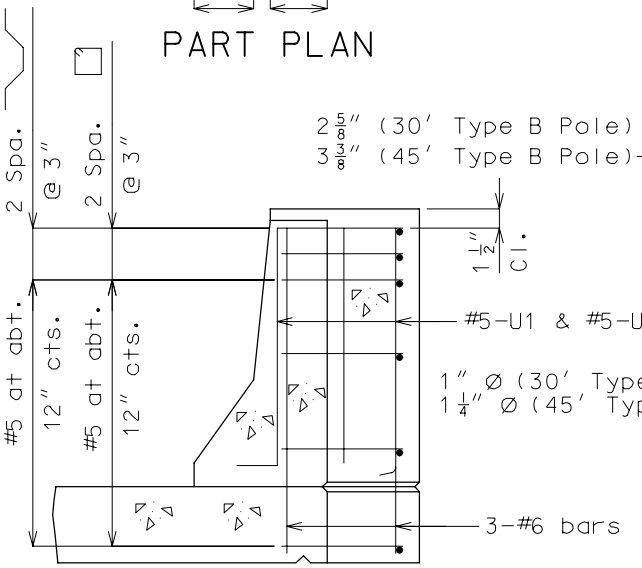
Safety Barrier Bridge Curb



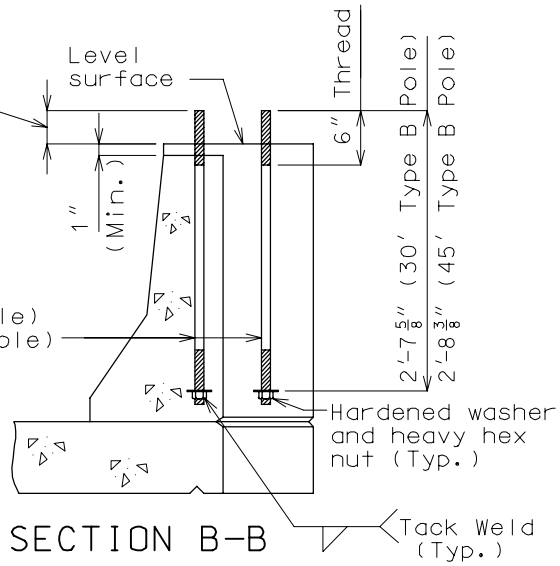
PART PLAN



PART PLAN

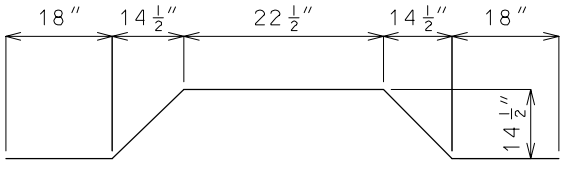


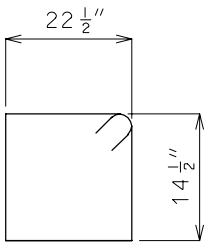
SECTION A-A

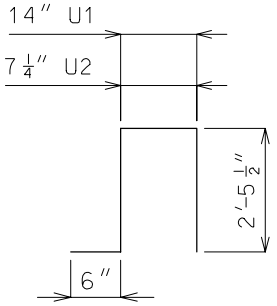


SECTION B-B

Note: Conduit not shown for clarity. See this section.





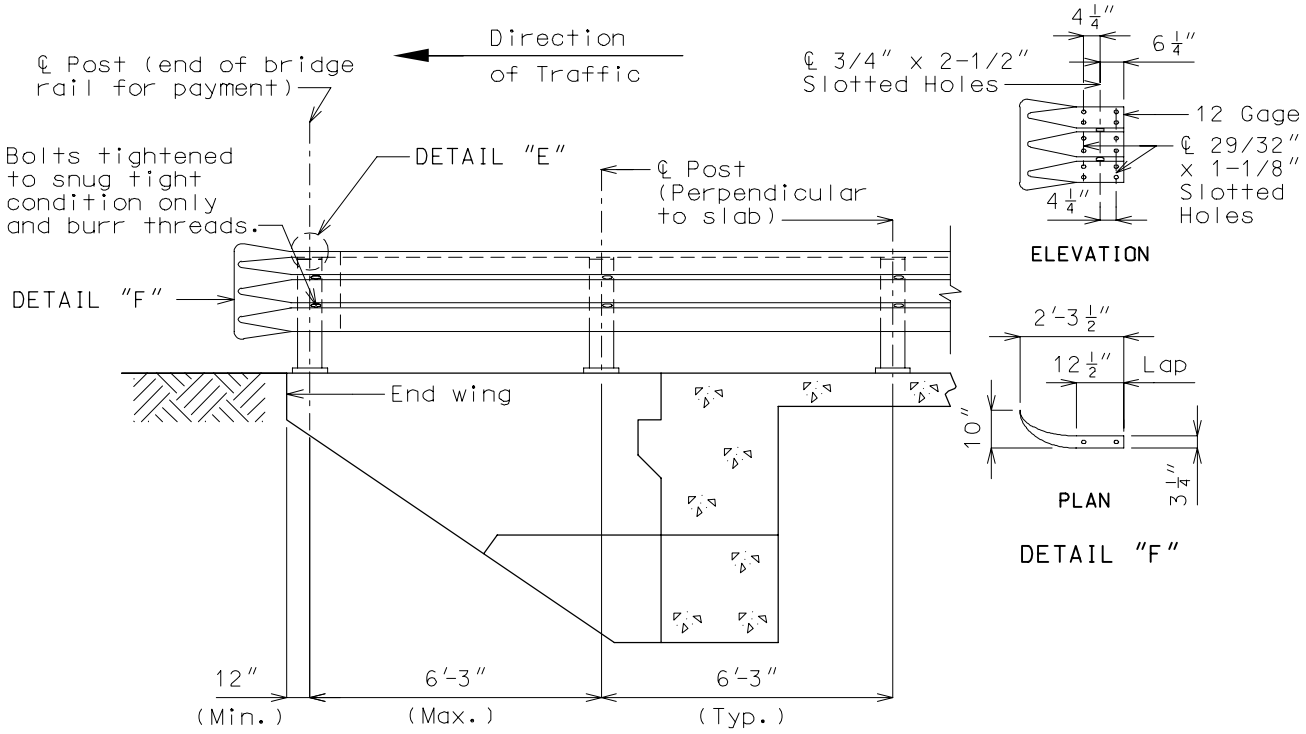


Anchor bolts and nuts shall be AASHTO M314-90 Grade 55. Anchor bolts, nuts and washers shall be fully galvanized.

Note to Detailer:
Extend slab transverse steel to edge of slab in blister region.

DETAILS AT END BENTS

Thrie Beam Bridge Rail

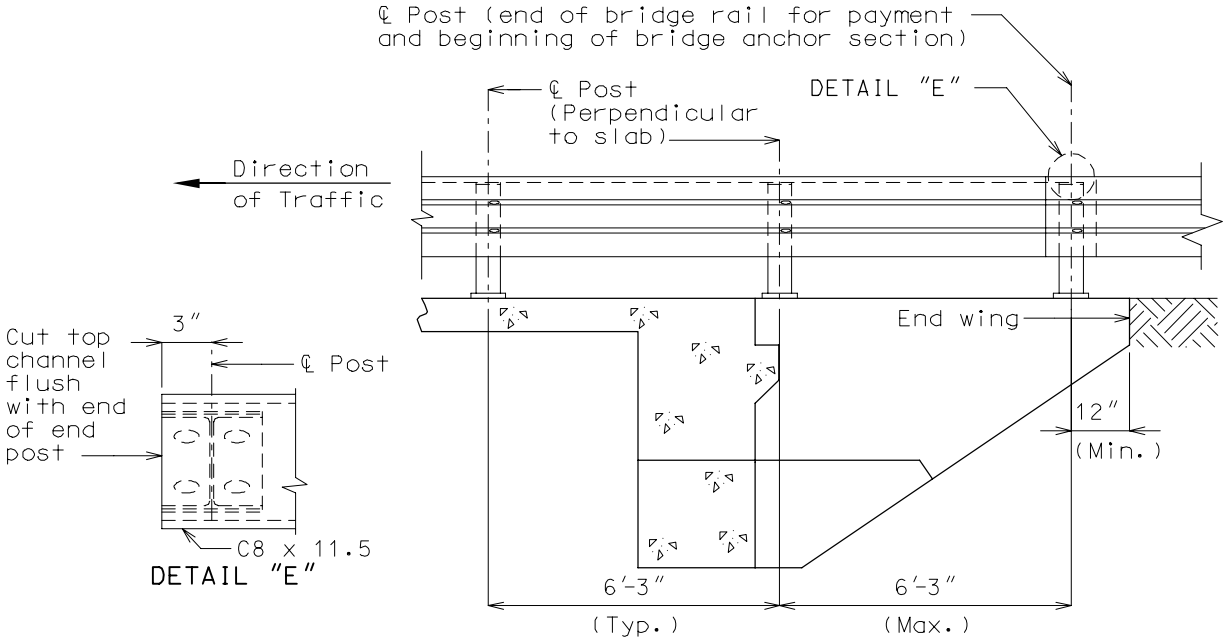


PART SECTION AT END BENT
SHOWING THRIE BEAM RAIL

Note: At bridge ends for two-way pavement, use guard rail at all four corners, and for divided pavement, use a guard rail at entrance ends only (unless required at exit end for a high fill).

Use a transition section on all state system structures and on all off-system structures which have guard rails on the approaches.

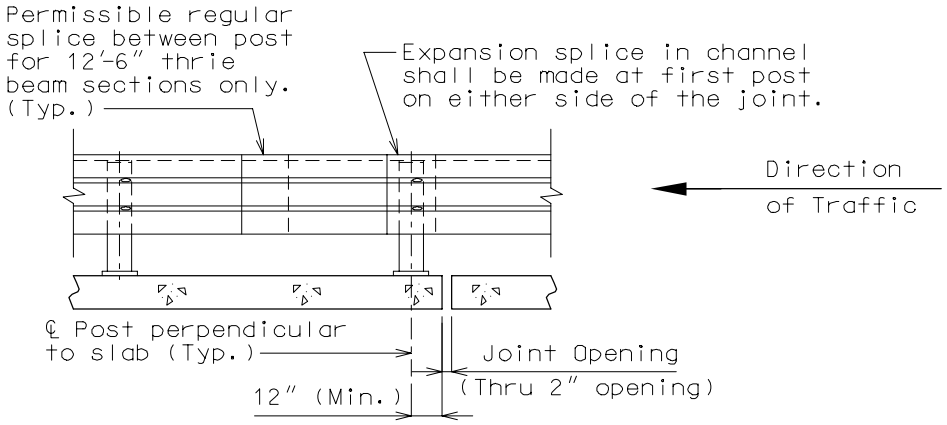
Use flared ends on off-system structures which do not have guard rails on approaches.



PART SECTION AT END BENT
SHOWING THRIE BEAM RAIL

DETAILS AT JOINT OPENINGS

JOINT OPENING (THRU 2″)



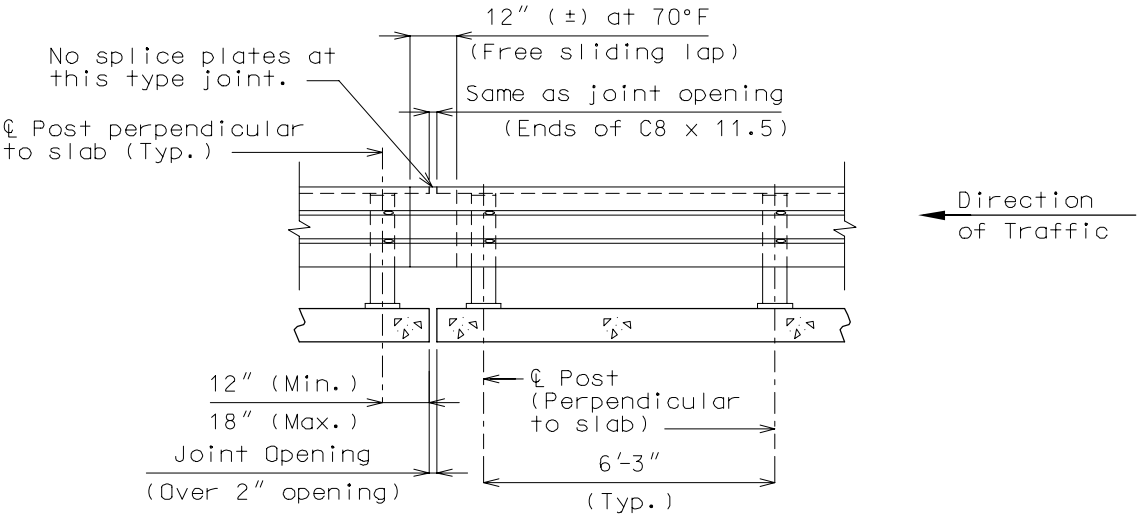
PART SECTION THRU SLAB
SHOWING THRIE BEAM RAIL

Note: Expansion splices in the Thrie Beam Rail shall be made at either the first or second post on either side of the joint and on structure at bridge ends.

When the splice is made at the second post, an expansion slot shall be provided in the Thrie Beam Rail for connection to the first post to allow for movement.

In addition to the expansion provision at these expansion joints. expansion splices in the Thrie Beam Rail and the channel shall be provided at other locations so that the maximum length with expansion provisions does not exceed 200 ft.

JOINT OPENING (OVER 2″)



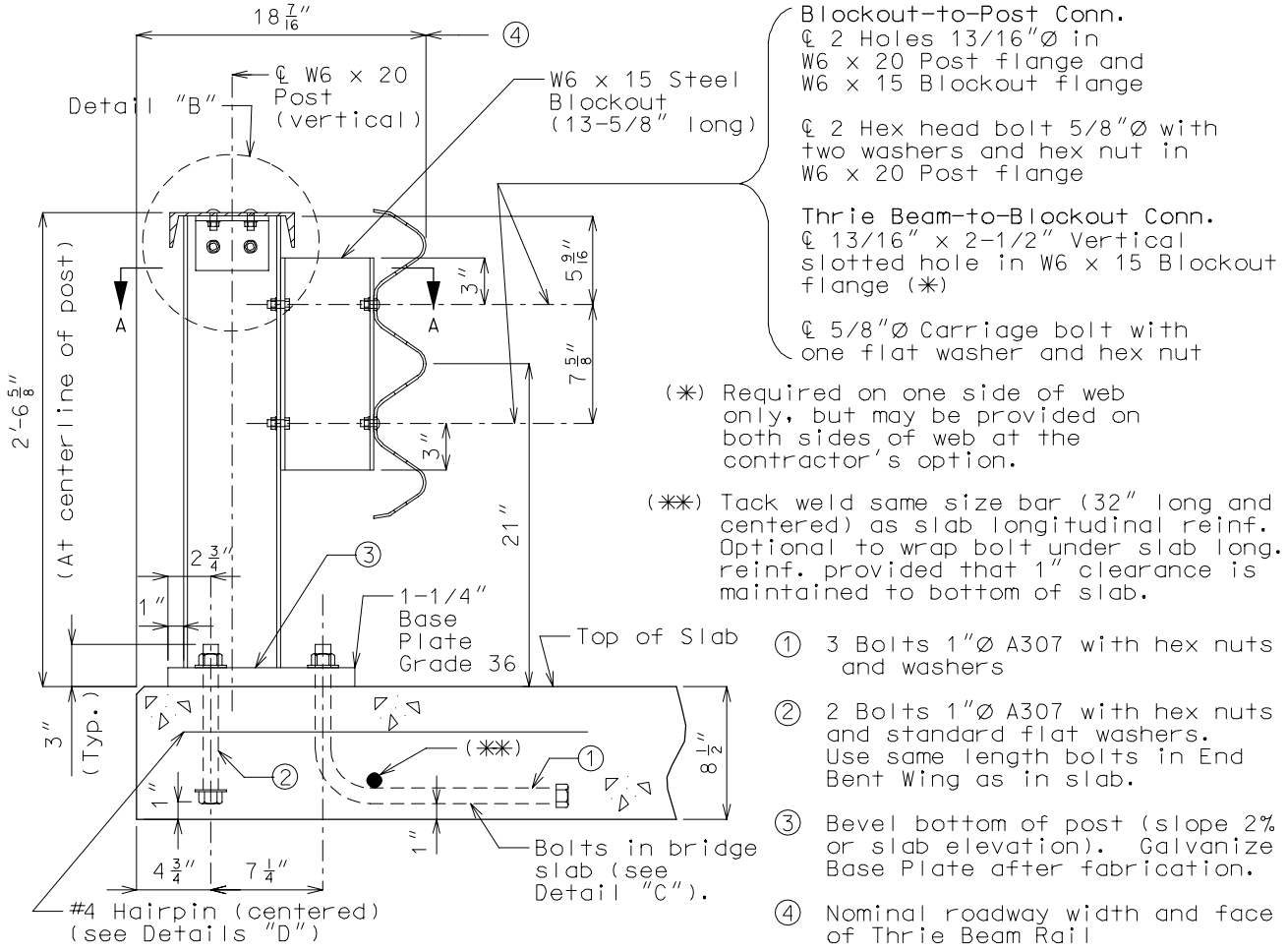
PART SECTION THRU SLAB
SHOWING THRIE BEAM RAIL

Note: See this bridge manual section for Thrie Beam Rail splice details and channel member details.

Thrie Beam Bridge Rail

SYSTEM 1: DETAILS AT RAIL POST TYPICAL CONNECTION

System 1: Applicable for new construction and all slab depths ≥ 8-1/2". Connection design load is 1.5 times plastic moment capacity (Mp) of W6 x 20 post. For details used for rehabilitation structures, see section 3.90.



(✳) Required on one side of web only, but may be provided on both sides of web at the contractor's option.

(✳✳) Tack weld same size bar (32" long and centered) as slab longitudinal reinf. Optional to wrap bolt under slab long. reinf. provided that 1" clearance is maintained to bottom of slab.

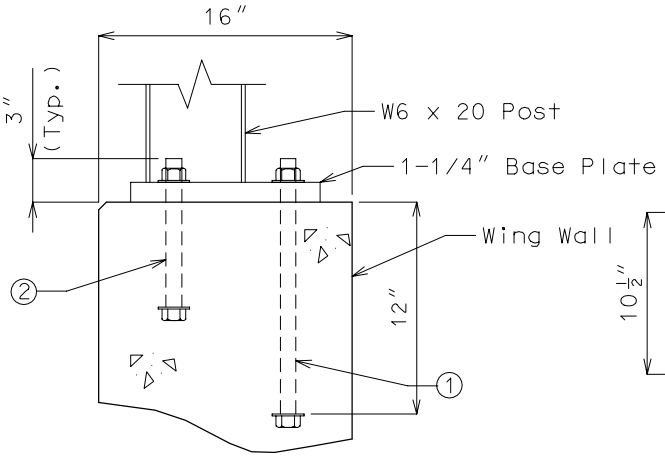
① 3 Bolts 1"Ø A307 with hex nuts and washers

② 2 Bolts 1"Ø A307 with hex nuts and standard flat washers. Use same length bolts in End Bent Wing as in slab.

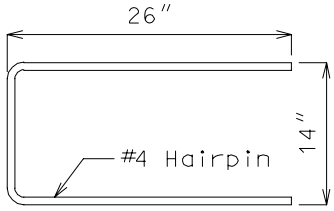
③ Bevel bottom of post (slope 2% or slab elevation). Galvanize Base Plate after fabrication.

④ Nominal roadway width and face of Thrie Beam Rail

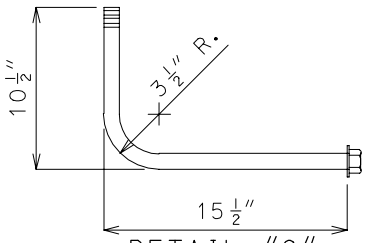
PART SECTION THRU SLAB AT RAIL POST



PART SECTION AT END BENT WING



DETAIL "D"

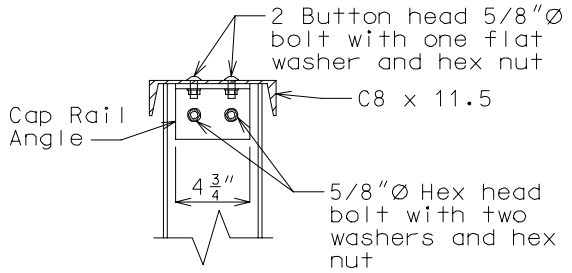


DETAIL "C"

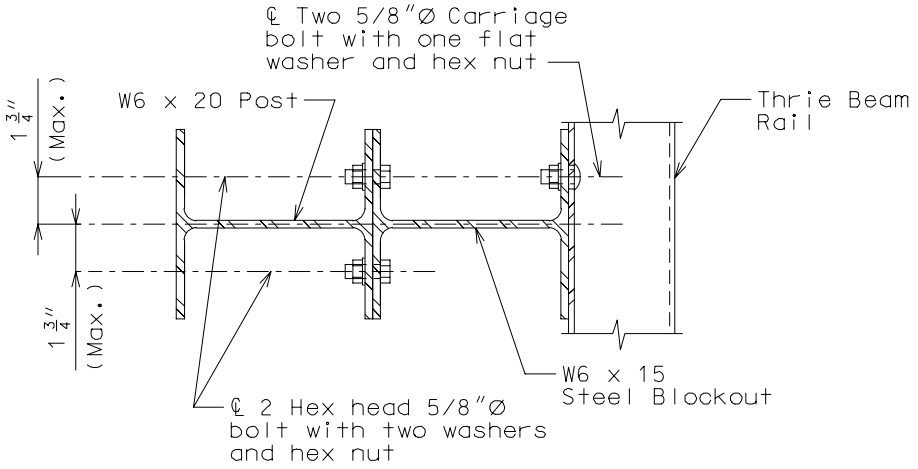
Bolt shall not be bent in slab depths greater than 14", use 12" straight embedment.

Note: Design weight of (12 gage) Thrie Beam Bridge Rail = 35#/lin. ft.

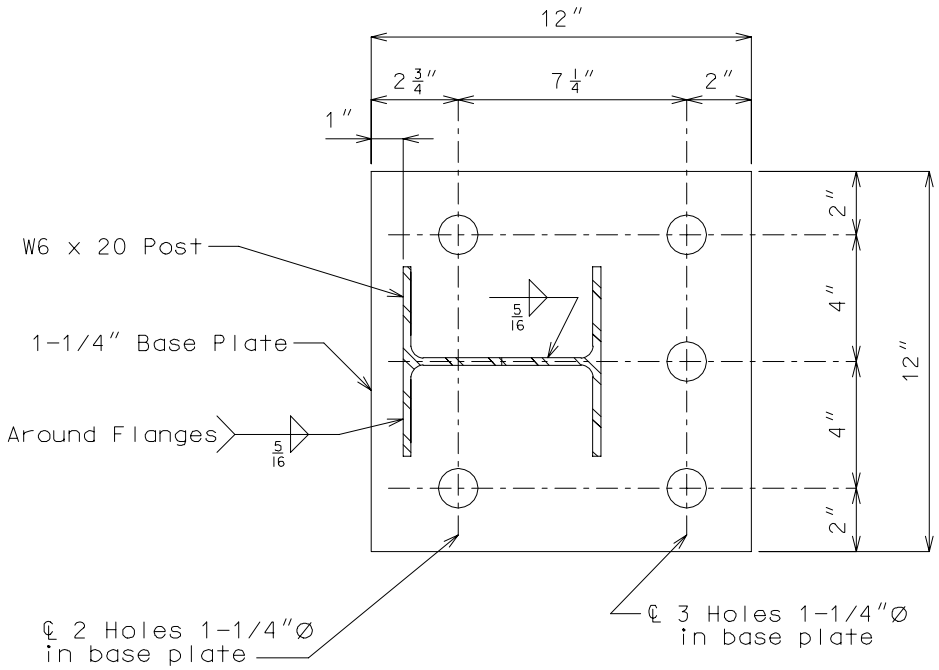
SYSTEM 1: DETAILS AT RAIL POST TYPICAL CONNECTION (CONT.)



DETAIL "B"



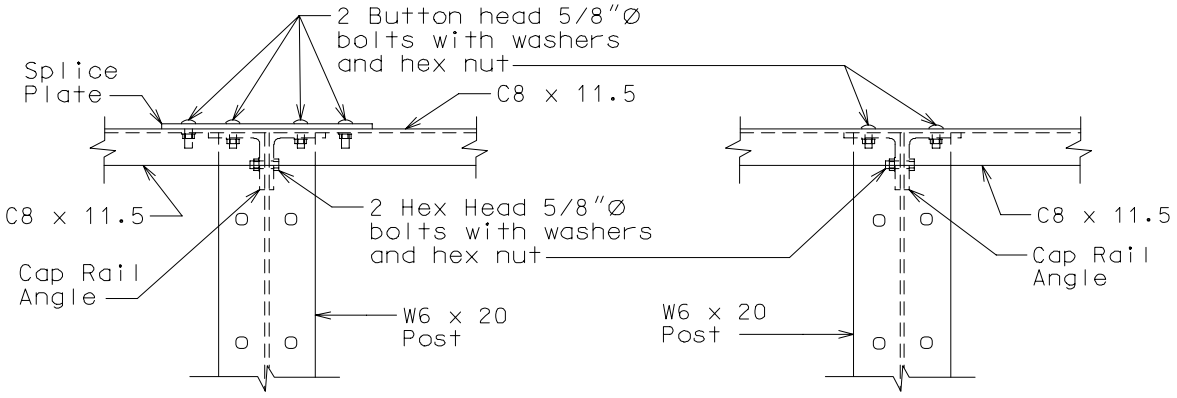
SECTION A-A



1-1/4" BASE PLATE

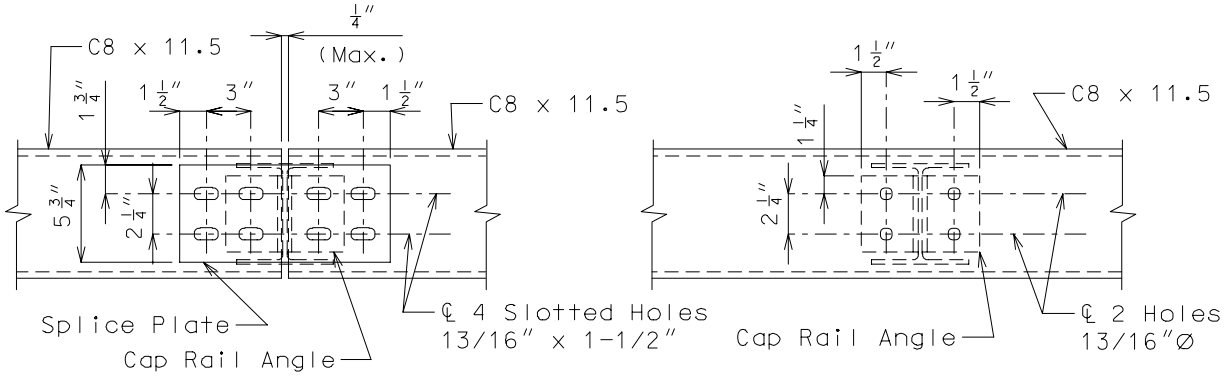
CHANNEL MEMBER DETAILS

Thrie Beam Bridge Rail



TYPICAL SPLICE ELEVATION

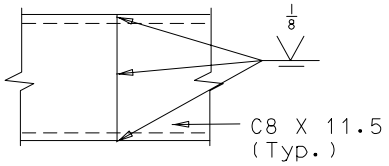
CONNECTION TO RAIL POST ELEVATION



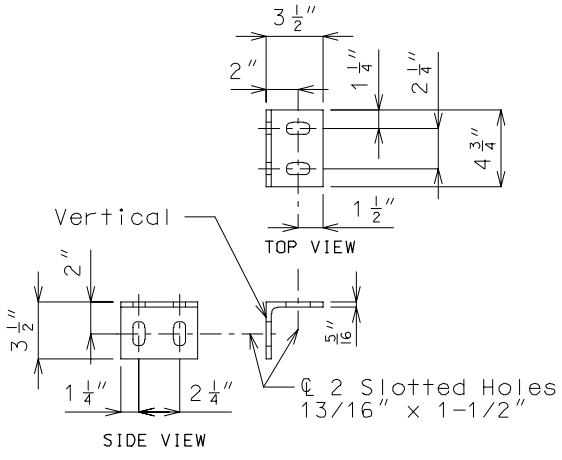
TYPICAL SPLICE PLAN

CONNECTION TO RAIL POST PLAN

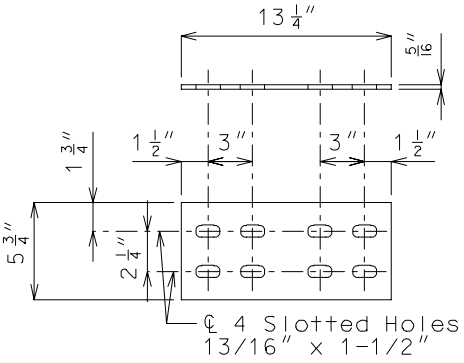
Shop or field splice at any location (Max. one per panel)



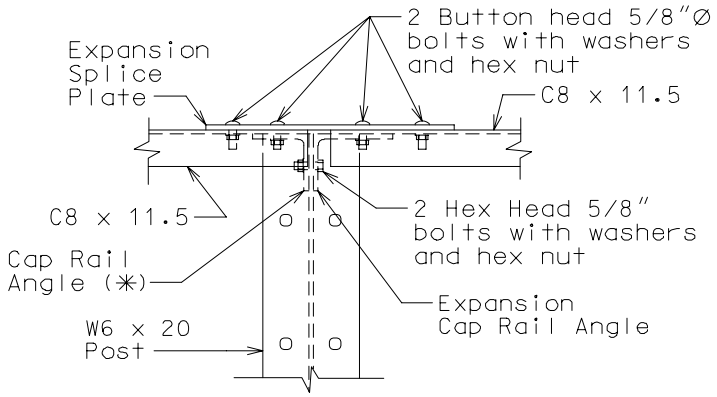
OPTIONAL SPLICE



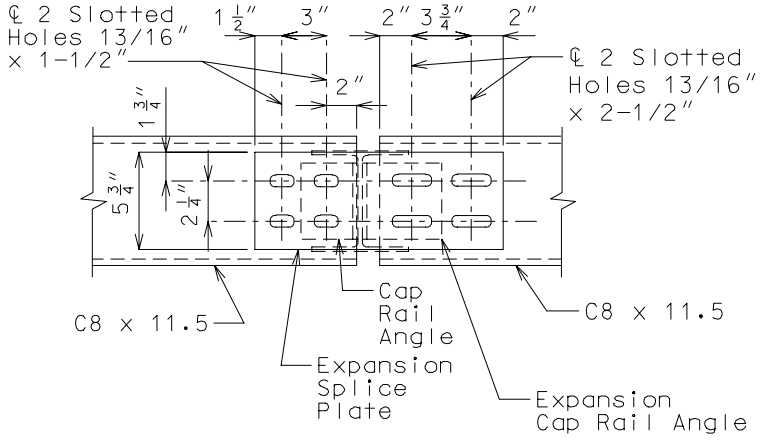
CAP RAIL ANGLE
(∠3-1/2 x 3-1/2 x 5/16)



SPLICE PLATE

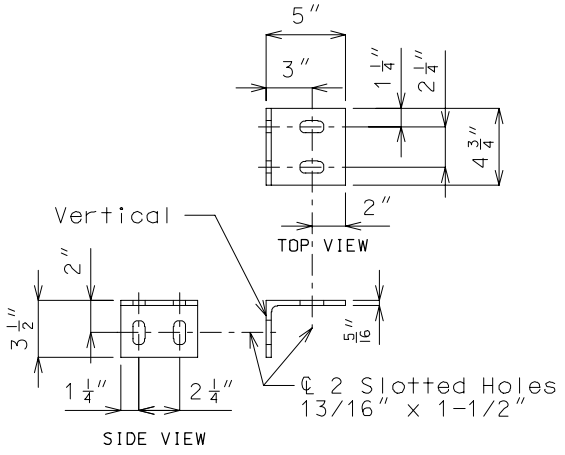


EXPANSION SPLICE ELEVATION

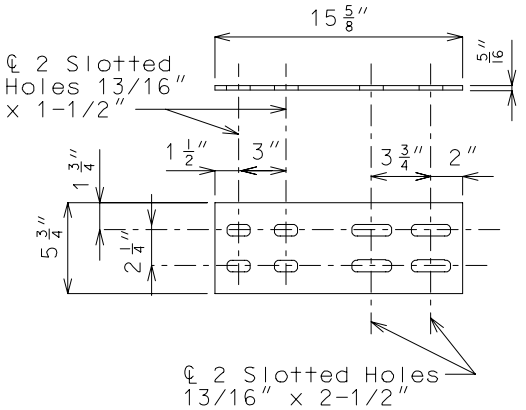


EXPANSION SPLICE PLAN

Expansion slots same side of post as exp. joint

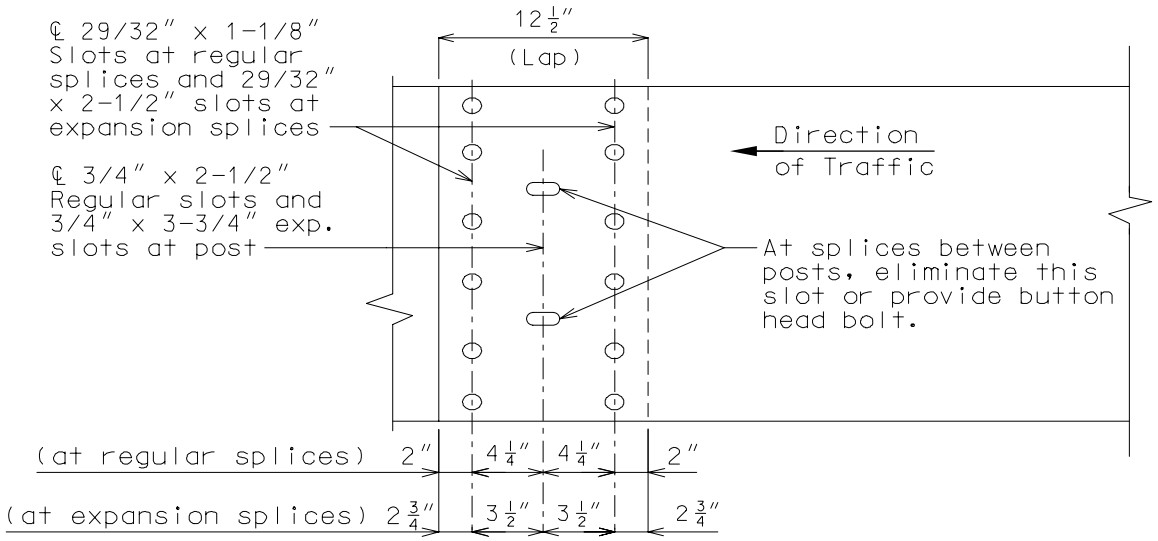


EXPANSION CAP RAIL ANGLE
(∠5 x 3-1/2 x 5/16)

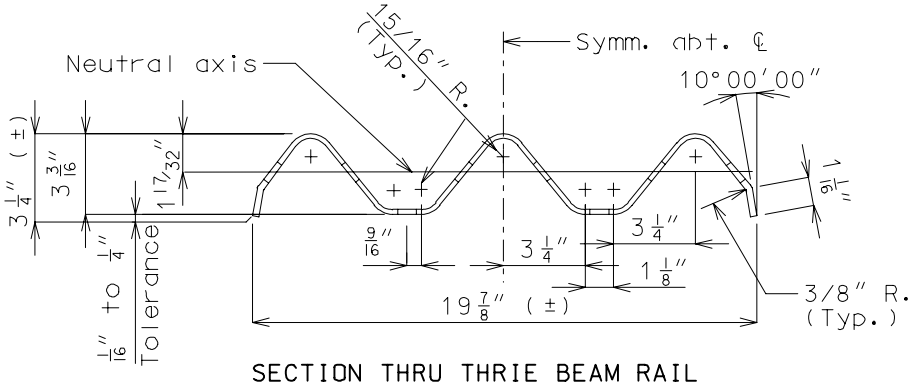


EXPANSION SPLICE PLATE

(*) For details of Cap Rail Angle, see page 6.1-5 of this section.



THRIE BEAM RAIL SPLICE DETAILS



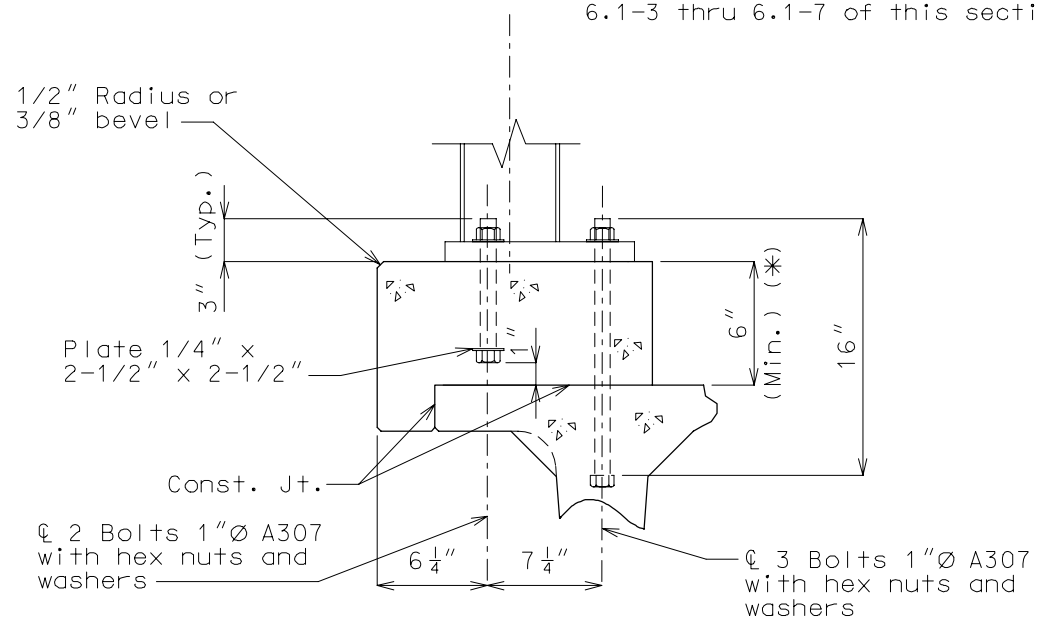
SECTION THRU THRIE BEAM RAIL

	10 Gage	12 Gage
Area	4.0 sq. in.	3.1 sq. in.
Section Modulus	2.80 cu. in.	2.19 cu. in.

Note: 5/8" Ø button head oval shoulder bolts with hex. nuts at all slots. (Thickness of hex. nuts = 3/8" min.). Special drilling of the thrie beam may be required at the splices. (All drilling details are to be shown on the shop drawings.)

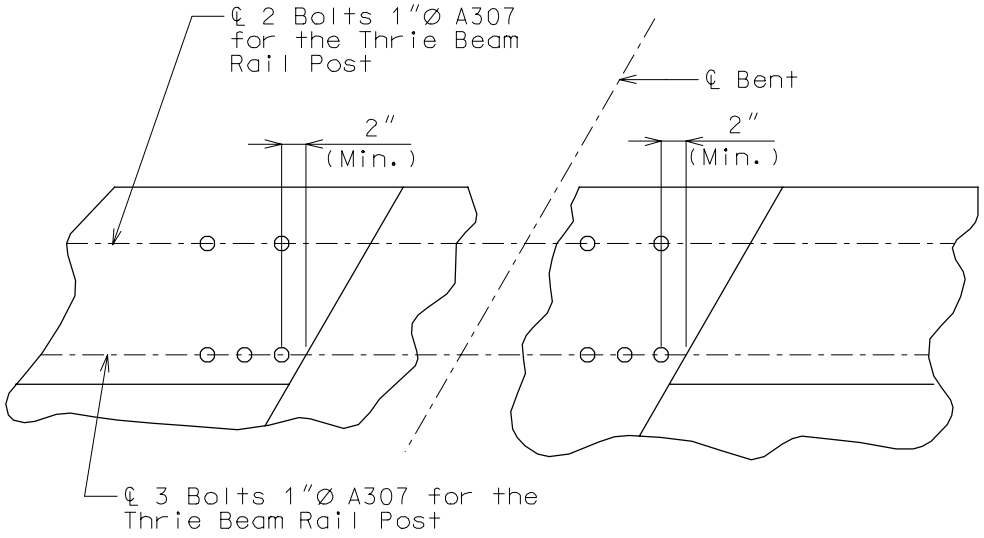
Note: Thrie Beam Rail weight = 10.6 lbs./ft. for 12 gage.

Note: For details not shown, see page 6.1-3 thru 6.1-7 of this section.



PART SECTION AT RAIL POST

(*) See Double-Tee Section in Bridge Manual.



BOLTS IN GIRDER BOLTS IN DIAPHRAGM

PART PLAN AT INTERMEDIATE BENT

Note: Adjust the Thrie Beam Rail Post spacing to meet the requirements as shown above.

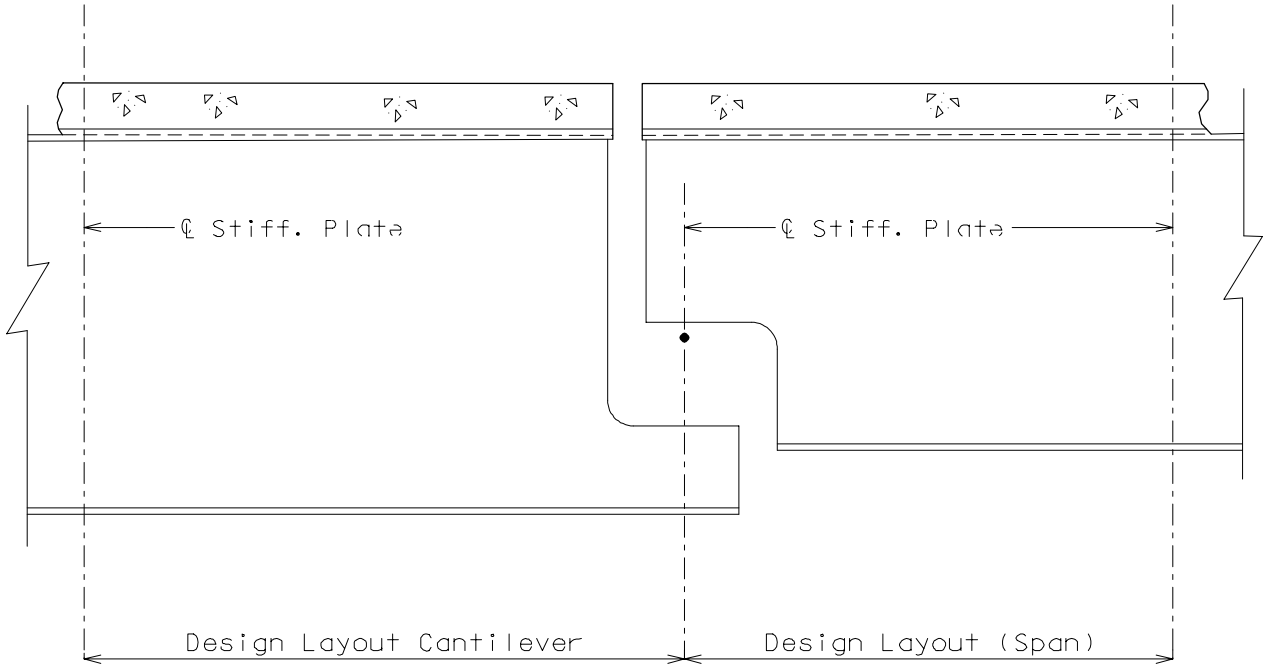
TABLE FOR THRIE BEAM RAIL ON HORIZONTAL CURVES

	Thrie Beam Rails on Horiztal Curves (*)		
	Radial to Face of Rail	Maximum Chord Length	Fabrication
Channel Member	Over 4,000′ Over 2,230′ - 4,000′ Over 1,250′ - 2,230′	43′-9″ 31′-3″ 25′-0″	Furnish and erect in straight rail panels.
	Over 480′ - 1,250′ Over 250′ - 480′	18′-9″ 6′-3″	Bevel weld chord sections of channel or fabricate to the required radius.
	Thru 250′	0	Fabricate to required radius.
Thrie Beam Rail	Over 150′		Furnish in straight sections.
	Thru 150′		Fabricate to required radius.

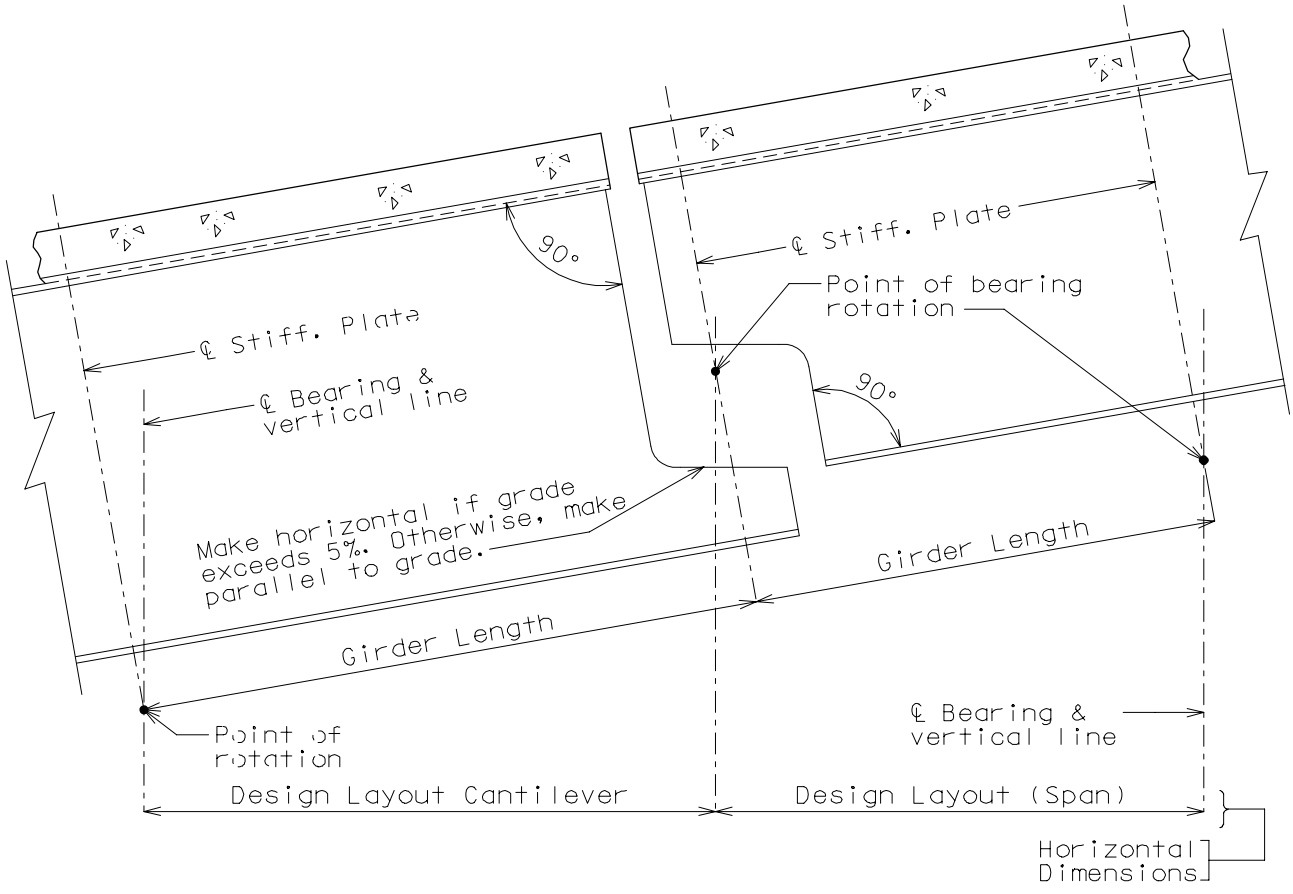
(*) Loss of half the tolerance provided between bolts and holes, or between splice plates and rail members has been allowed in determining these controls.

HINGED BEAM CONNECTIONS (CONT.)

Longitudinal Diagrams



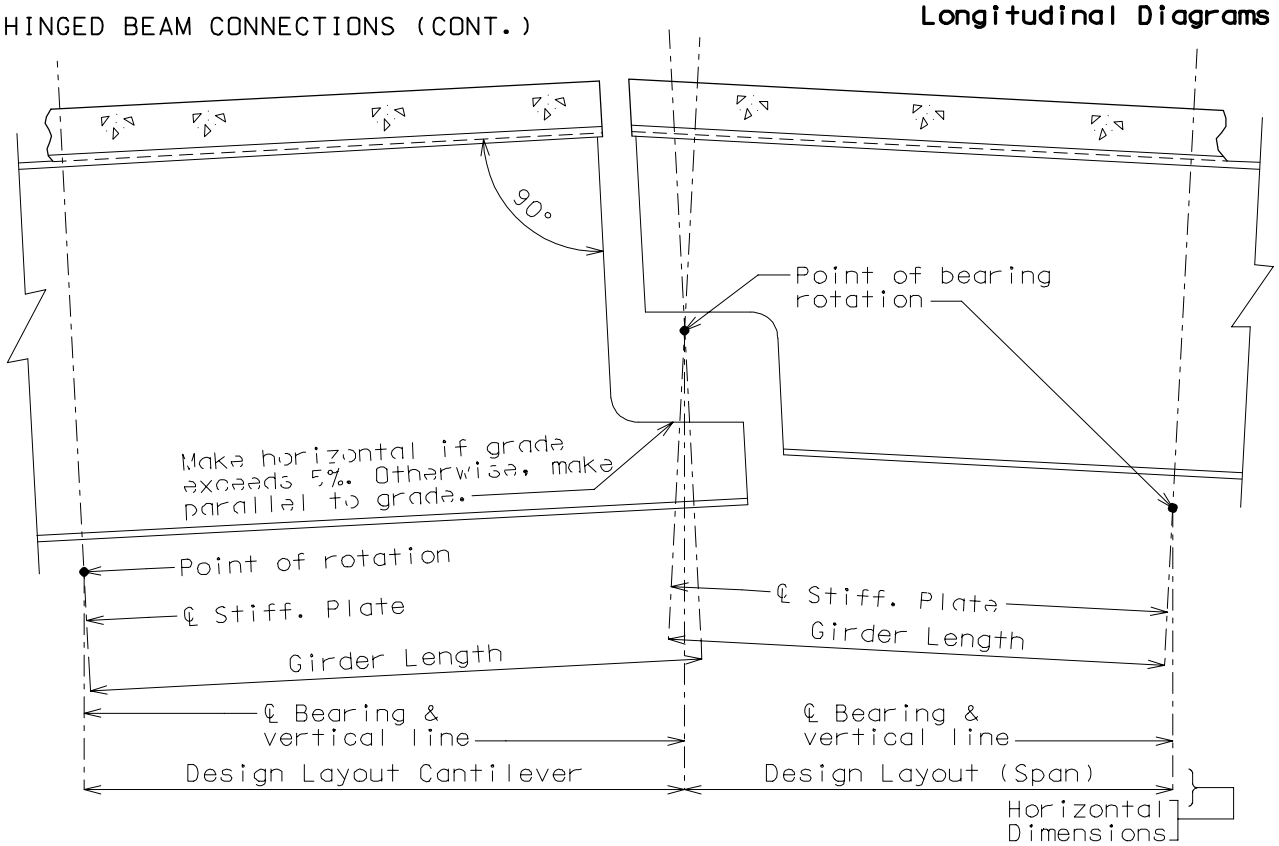
GEOMETRICS FOR HINGED BEAM CONNECTIONS
FOR BRIDGES ON FLAT GRADE



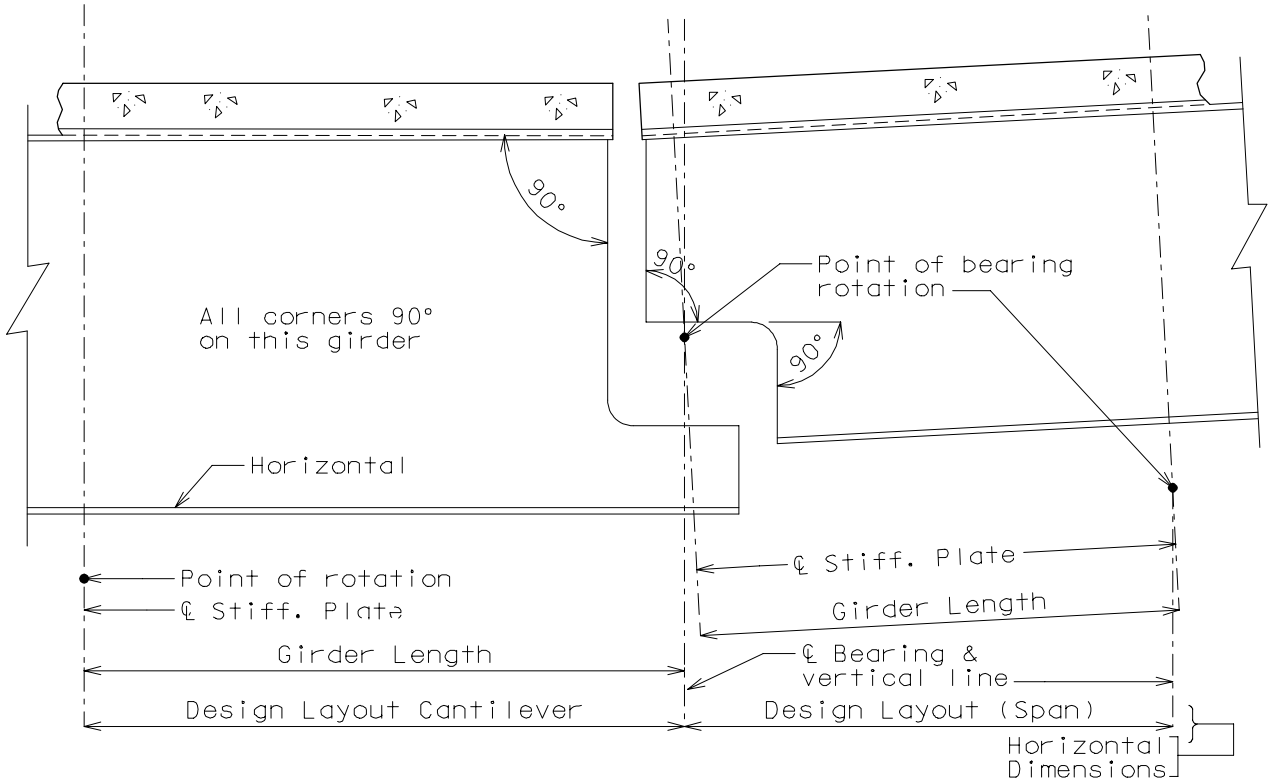
GEOMETRICS FOR HINGED BEAM CONNECTIONS
FOR BRIDGES ON STRAIGHT, PLUS GRADES

HINGED BEAM CONNECTIONS (CONT.)

Longitudinal Diagrams



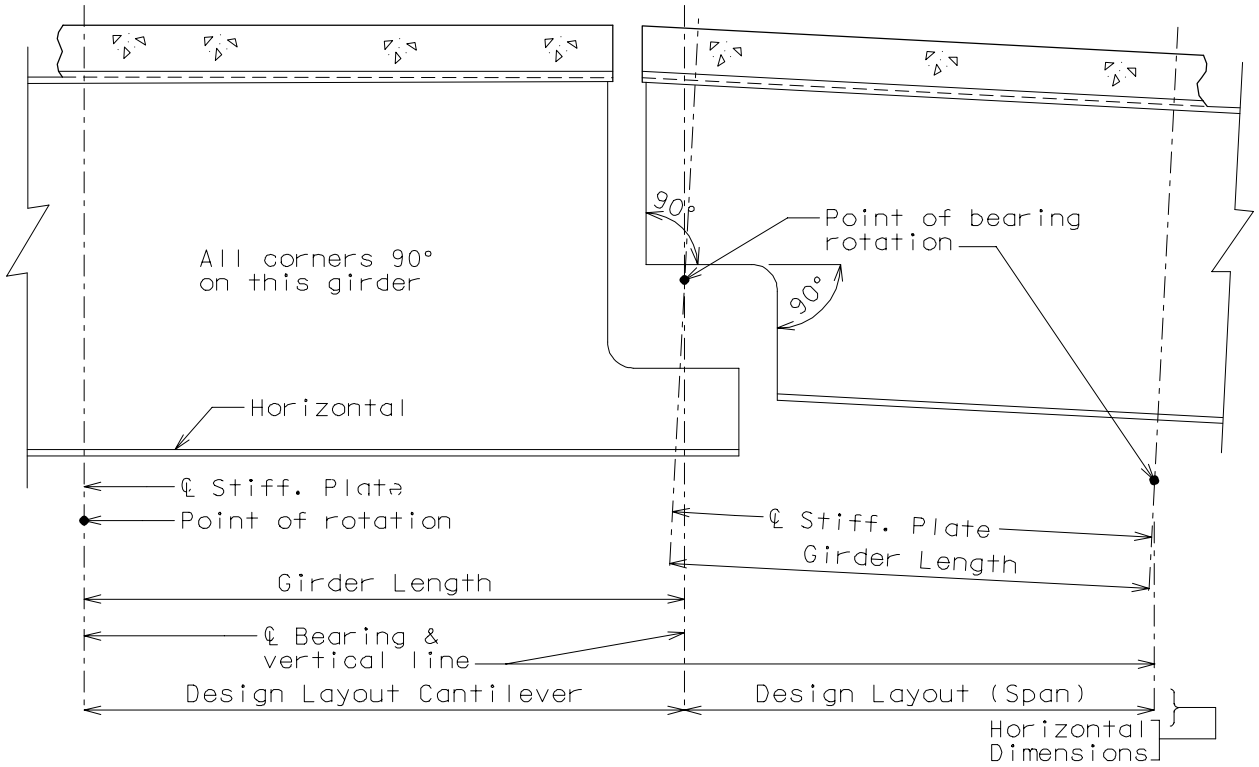
GEOMETRICS FOR HINGED BEAM CONNECTIONS FOR BRIDGES ON CROWN VERTICAL CURVES



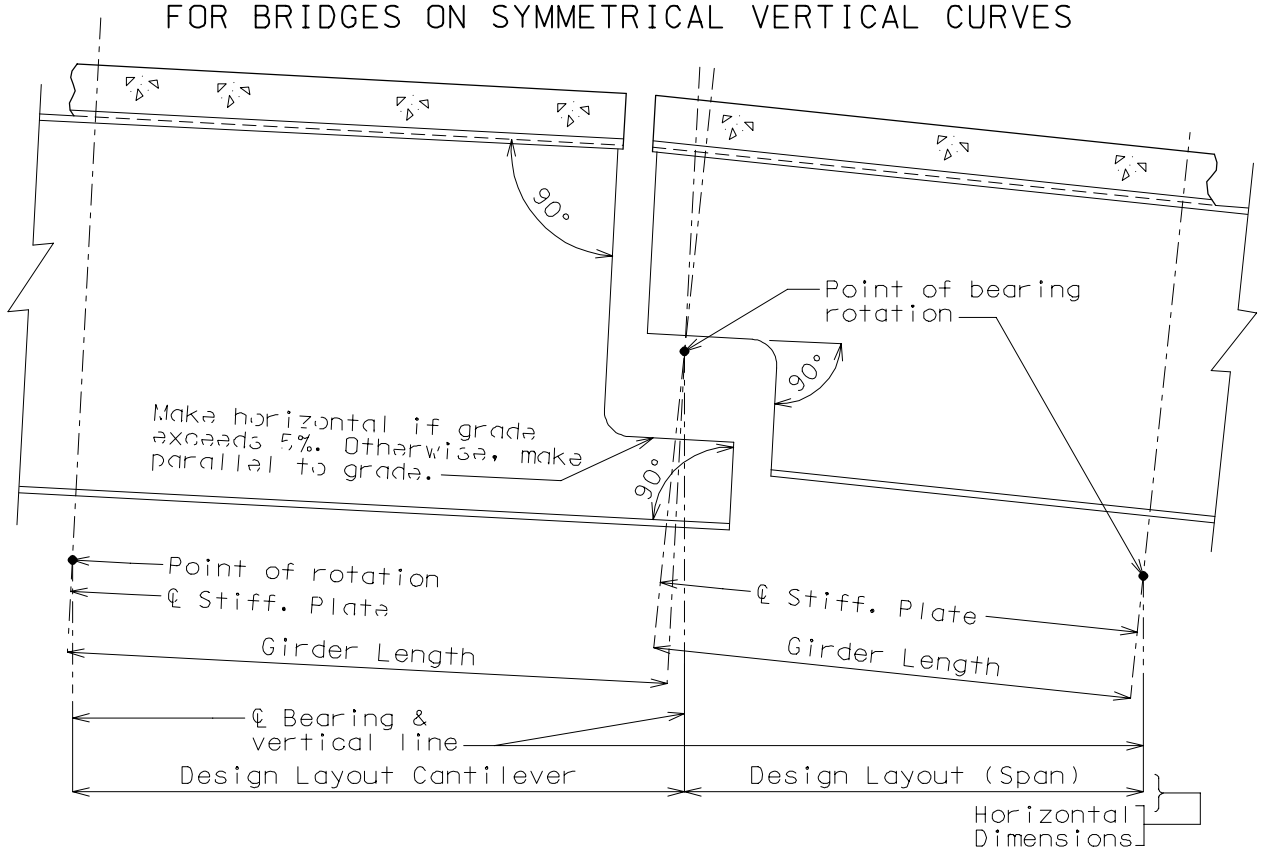
GEOMETRICS FOR HINGED BEAM CONNECTIONS FOR BRIDGES ON SAG VERTICAL CURVES

HINGED BEAM CONNECTIONS (CONT.)

Longitudinal Diagrams



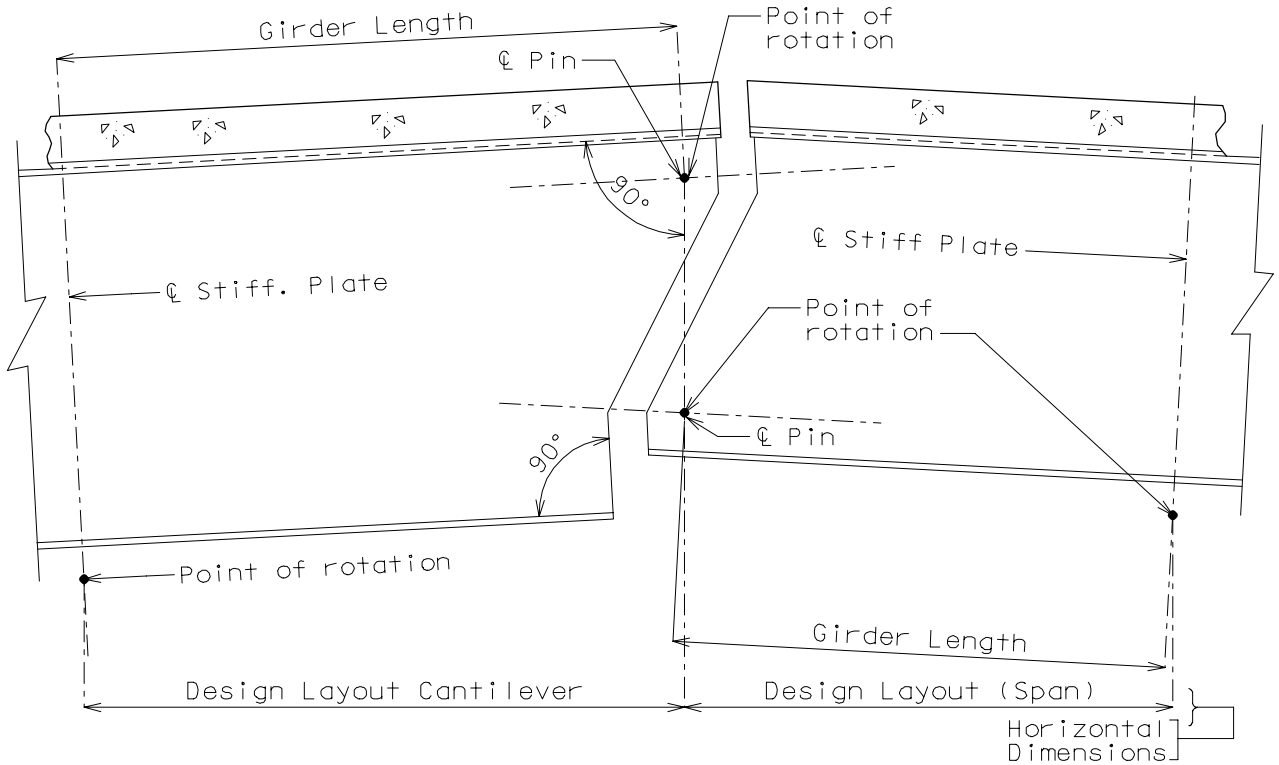
GEOMETRICS FOR HINGED BEAM CONNECTIONS
FOR BRIDGES ON SYMMETRICAL VERTICAL CURVES



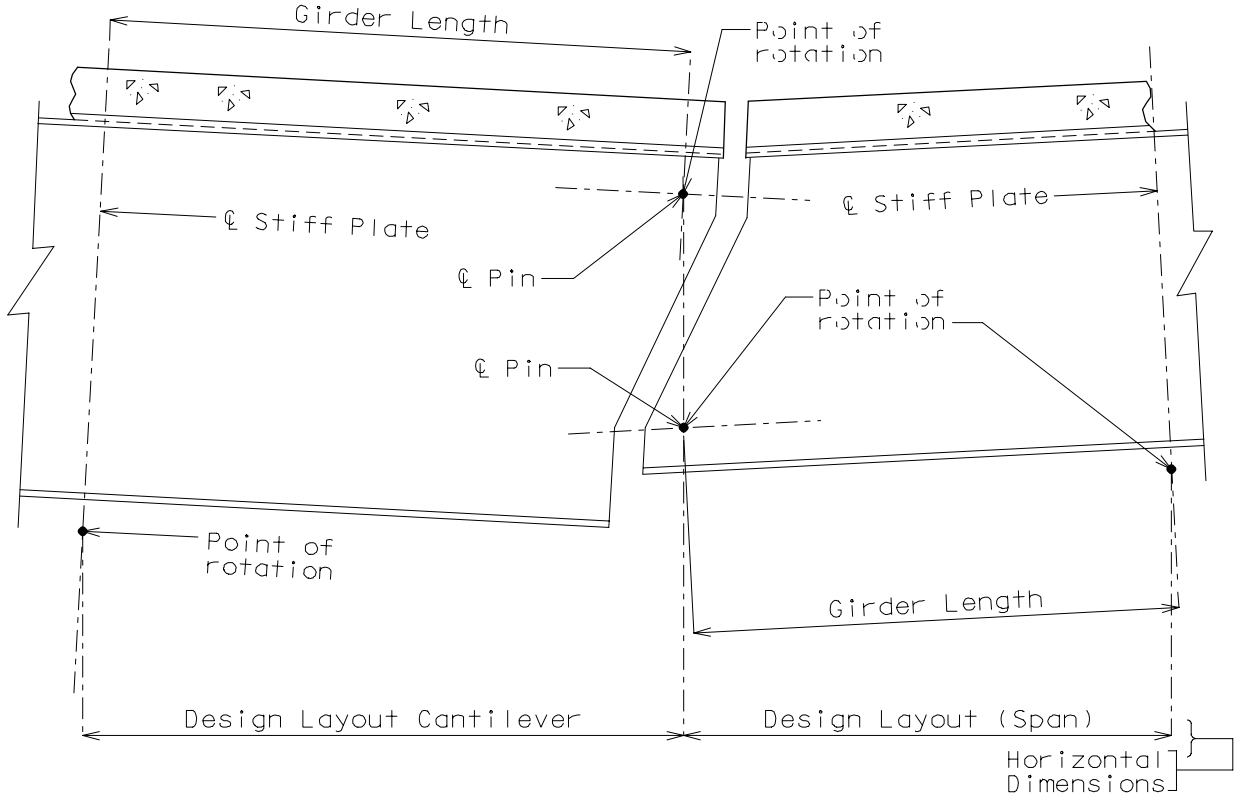
GEOMETRICS FOR HINGED BEAM CONNECTIONS
FOR BRIDGES ON CROWN VERTICAL CURVES

HANGER BEAM CONNECTIONS

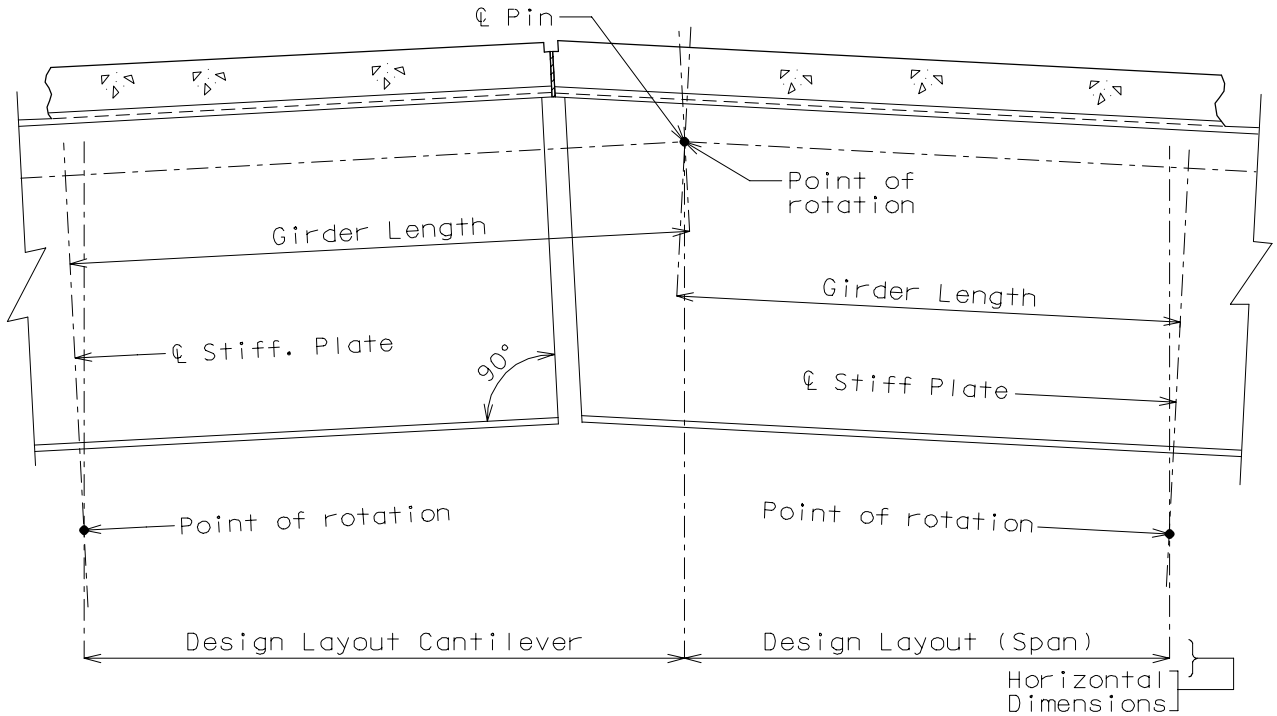
Longitudinal Diagrams



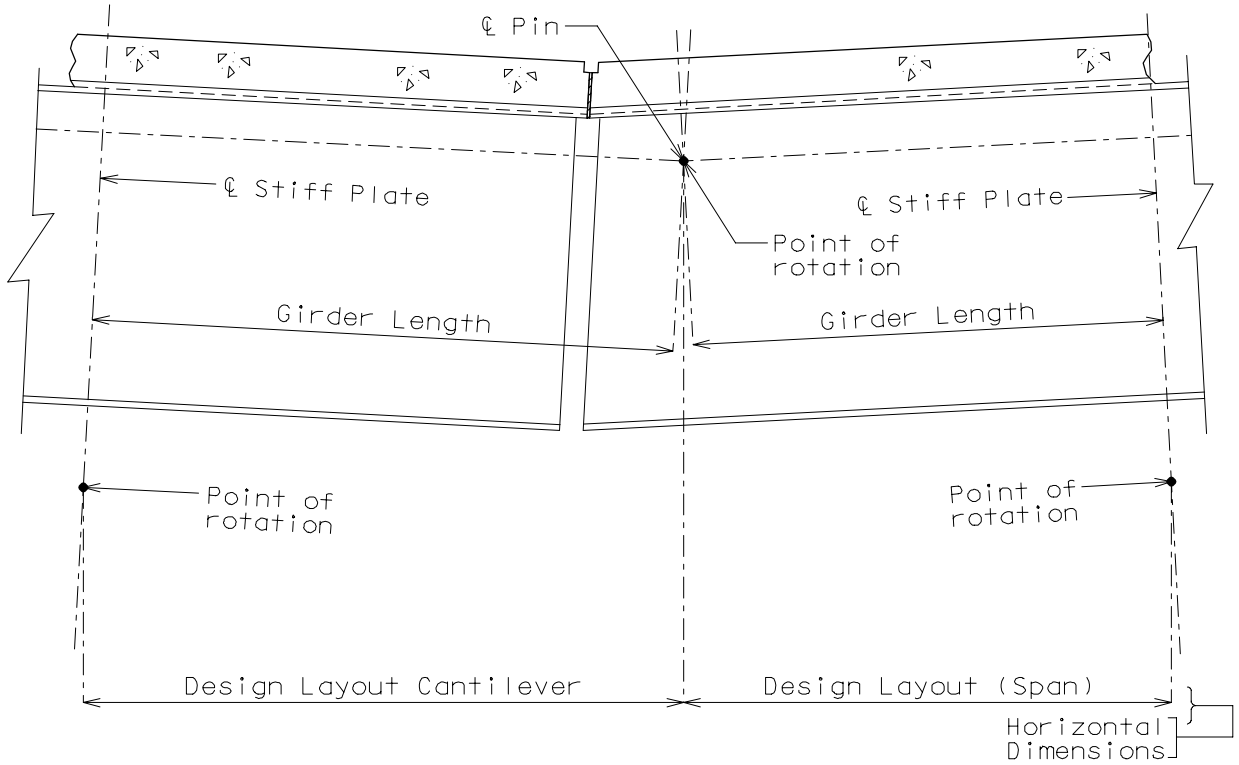
GEOMETRICS FOR HANGER BEAM CONNECTIONS
FOR BRIDGES ON CROWN VERTICAL CURVES



GEOMETRICS FOR HANGER BEAM CONNECTIONS
FOR BRIDGES ON SAG VERTICAL CURVES



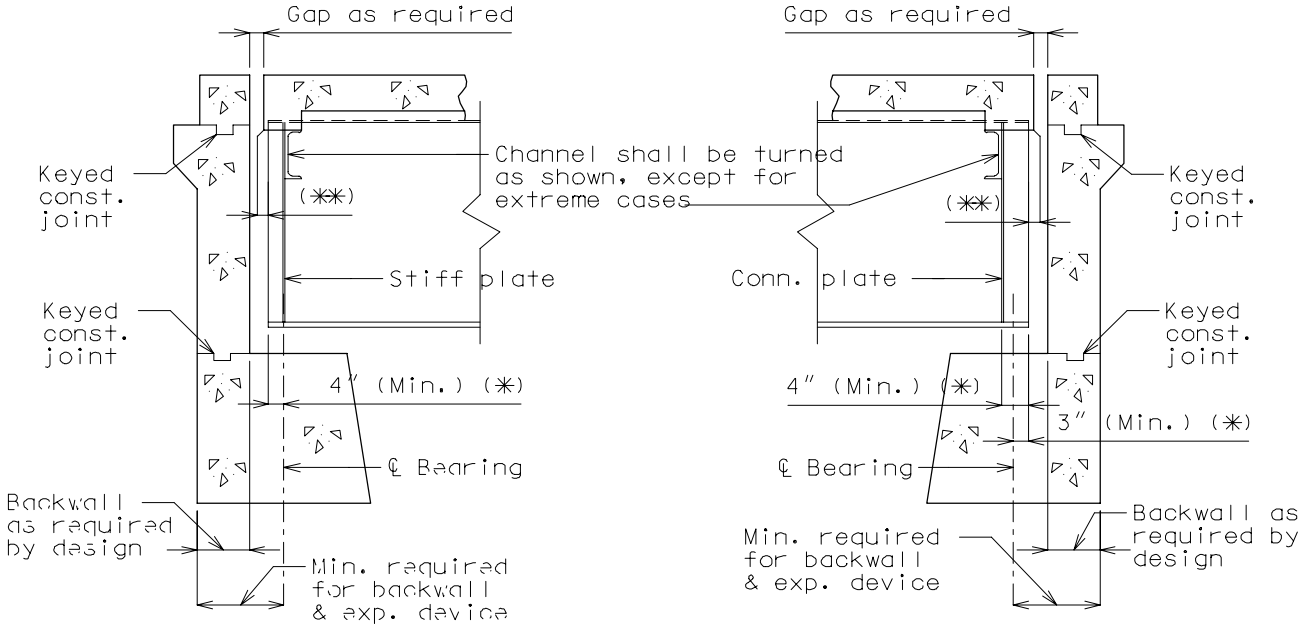
GEOMETRICS FOR PIN PLATE CONNECTIONS
FOR BRIDGES ON CROWN VERTICAL CURVES



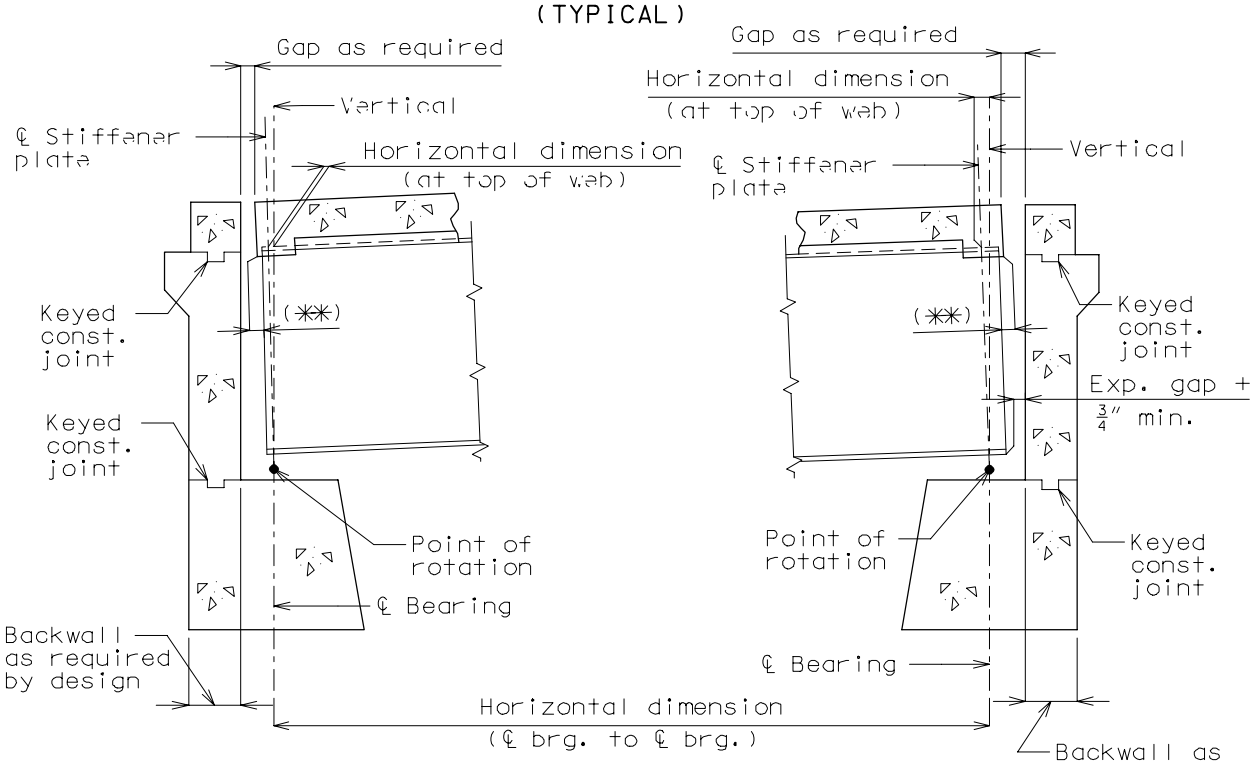
GEOMETRICS FOR PIN PLATE CONNECTIONS
FOR BRIDGES ON SAG VERTICAL CURVES

LONGITUDINAL SECTIONS (STEEL STRUCTURES)
EXPANSION DEVICE AT END BENT

Longitudinal Diagrams



STRUCTURES NOT ON GRADE
(TYPICAL)



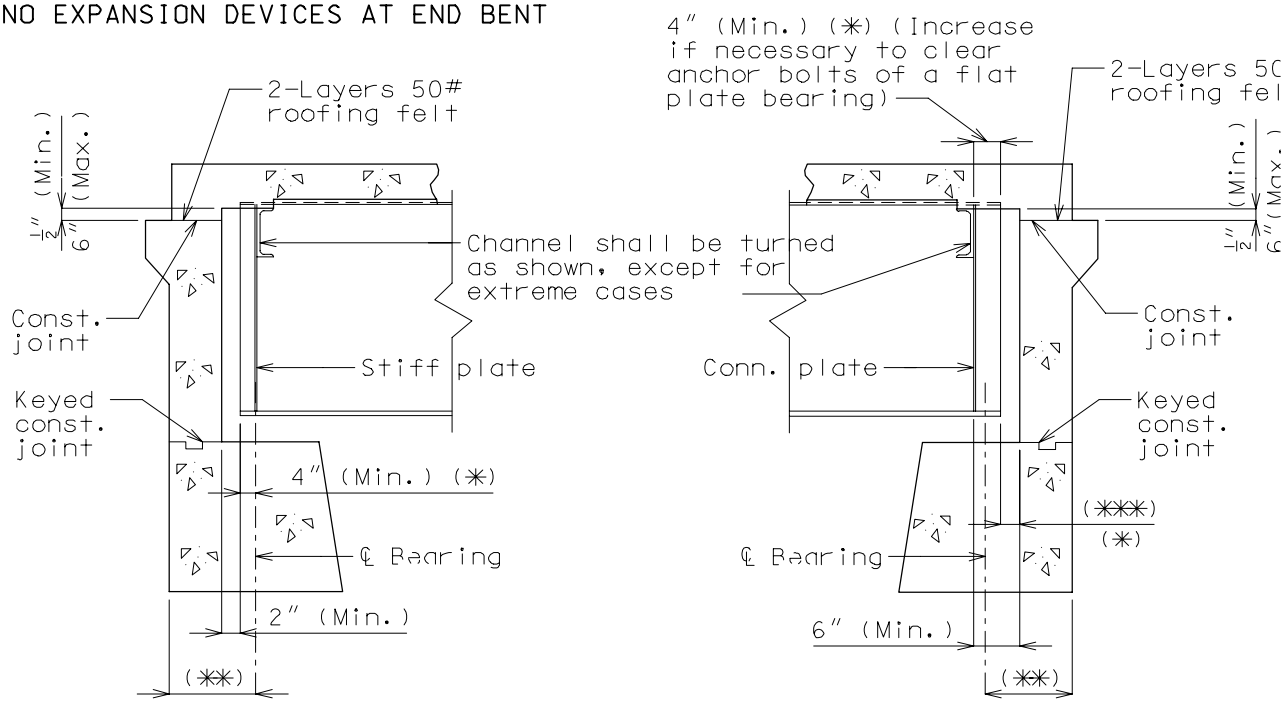
STRUCTURES ON GRADE
(TYPICAL)

(*) Parallel to Girder. All other dimensions shown are normal to backwall.

(**) See Bridge Manual Expansion Device Section (3.35) for dimension of overhang from end of stringer or girder to face of plate, edge of concrete or face of vertical leg of angle.

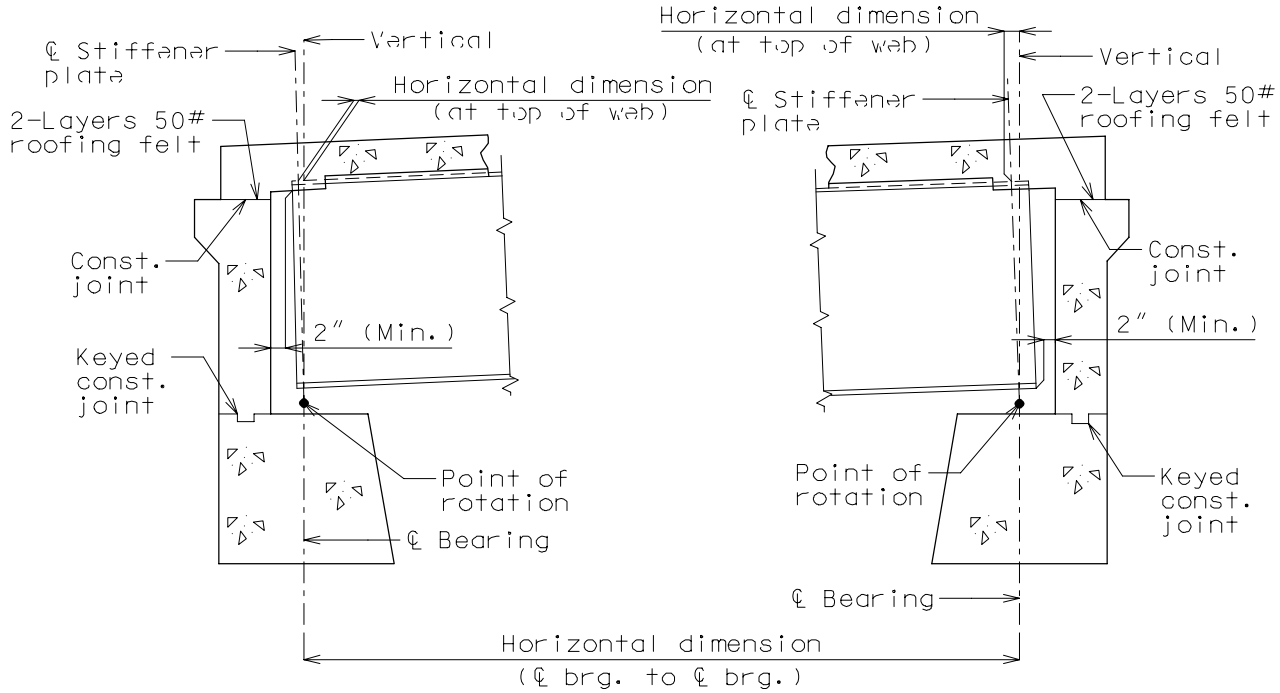
LONGITUDINAL SECTIONS (STEEL STRUCTURES) (CONT.) **Longitudinal Diagrams**

NO EXPANSION DEVICES AT END BENT



BEARING STIFFENER CONNECTION PLATE

STRUCTURES NOT ON GRADE
(TYPICAL)



STRUCTURES ON GRADE
(TYPICAL)

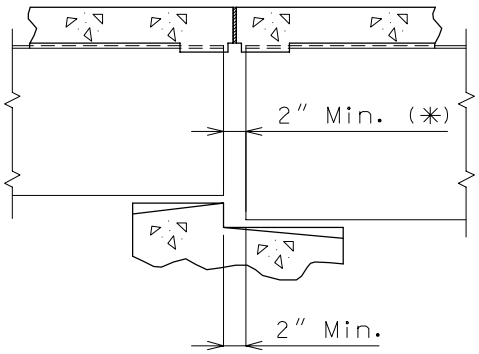
(*) Parallel to Girder. All other dimensions shown are normal to backwall.

(**) 18" min. (Use same dimension as the expansion device end on 3-span continuous, if it is not more than 2" greater.)

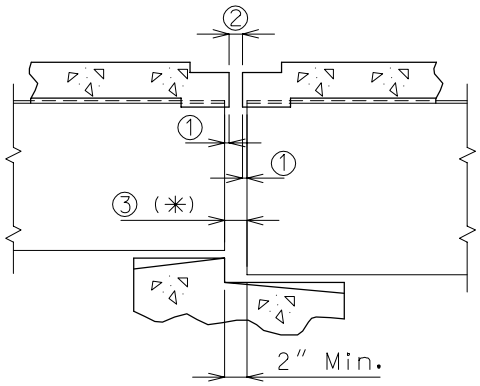
(***) 3" min. for type C, D and E bearing, and 2" min. for an elastomeric bearing.

LONGITUDINAL SECTIONS (STEEL STRUCTURE) (CONT.)
INTERMEDIATE BENT

Longitudinal Diagrams



NO EXPANSION DEVICE



EXPANSION DEVICE

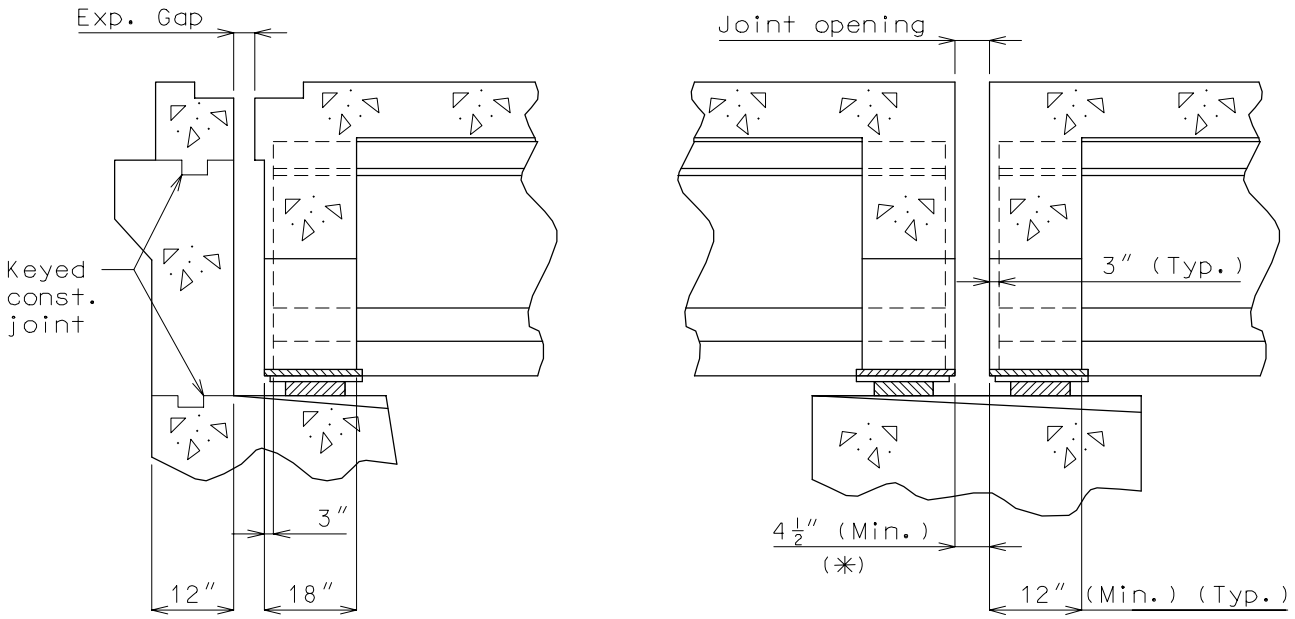
① 1/2" minimum overhang from end of stringer to face of plate, edge of concrete or face of vertical leg of angle.
② Gap as required for a particular type of expansion device.
③ Expansion device gap plus 1-1/2" minimum (taken parallel to ℄ stringer).

(*) Parallel to Girder. All other dimensions shown are normal to ℄ Bent.

Blockout shown is for Elastomeric Expansion Joint Seal. Check Design Layout for type of device for a particular structure.

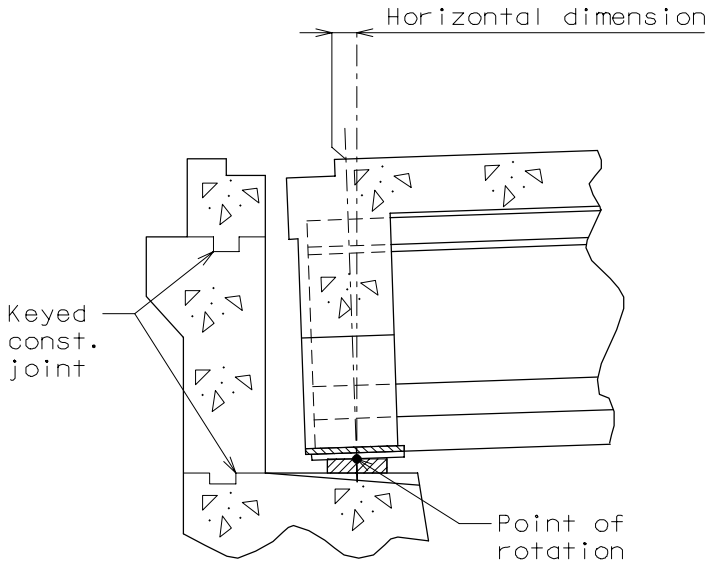
LONGITUDINAL SECTIONS (PRESTRESSED STRUCTURE)
EXPANSION DEVICE AT ANY BENT

Longitudinal Diagrams



STRUCTURES NOT ON GRADE
(TYPICAL)

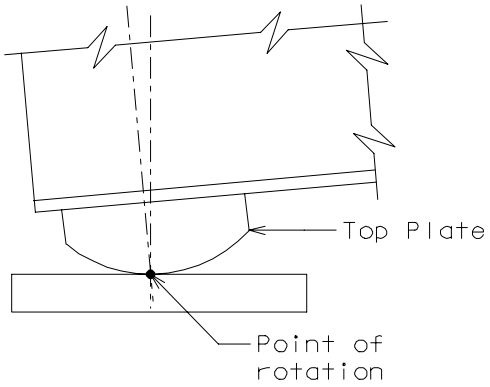
(✳) Parallel to Girder. All other dimensions shown are normal to ℄ Bent.



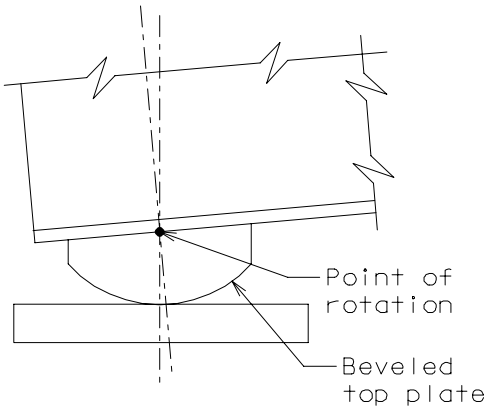
STRUCTURES ON GRADE
(TYPICAL)

LONGITUDINAL SECTIONS
POINT OF ROTATION OF BEARINGS

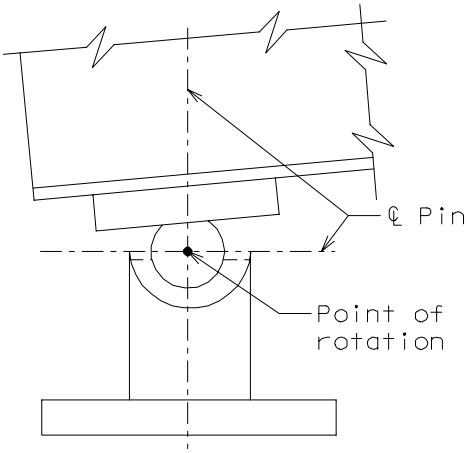
Longitudinal Diagrams



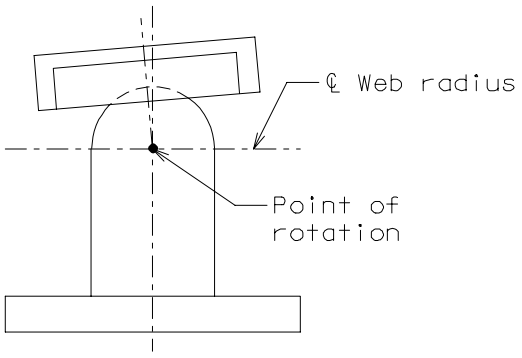
TYPE "C" BEARING



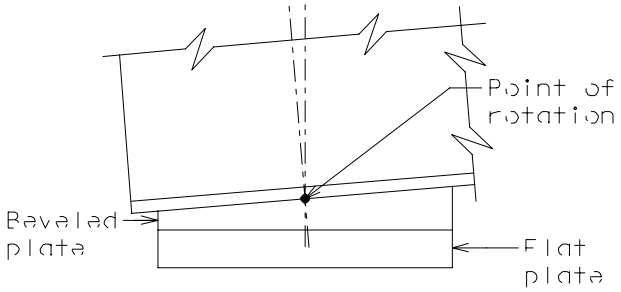
TYPE "C" BEARING
(GRADE 4% AND GREATER)



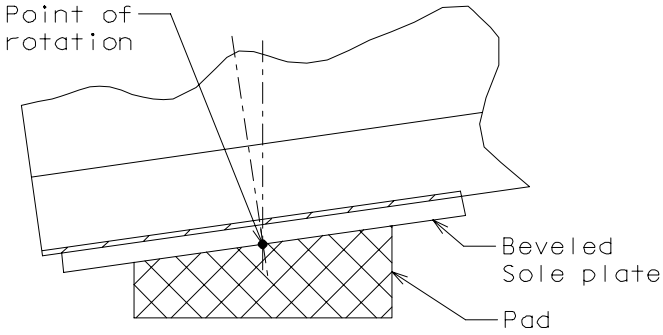
TYPE "D" BEARING



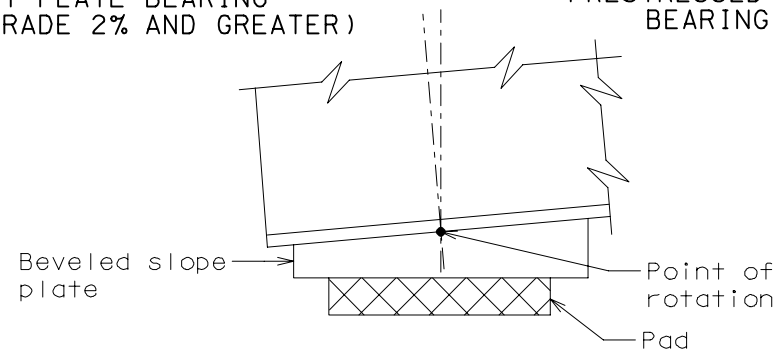
TYPE "E" BEARING



FLAT PLATE BEARING
(FOR GRADE 2% AND GREATER)



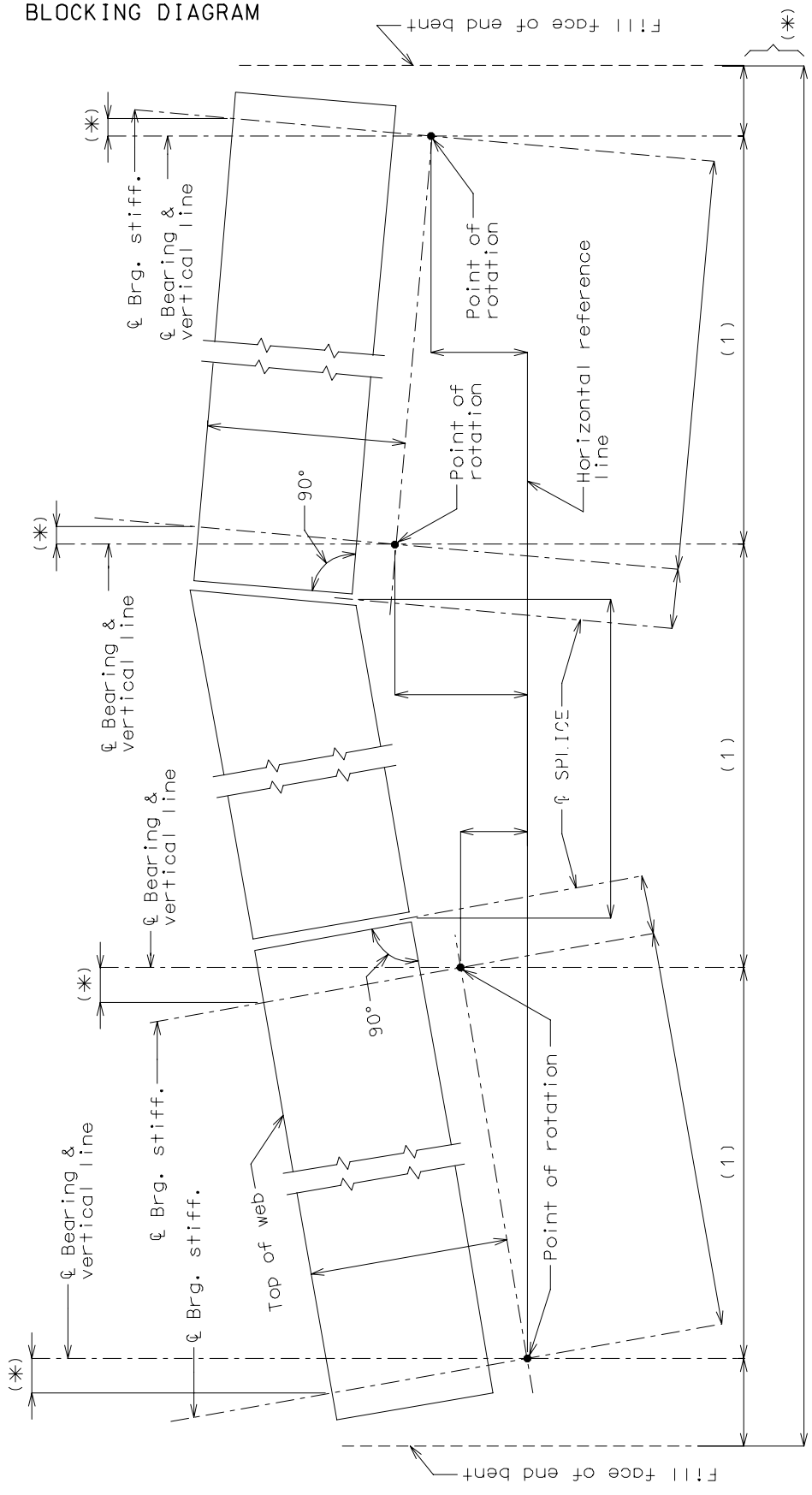
PRESTRESSED STRUCTURE
BEARING PAD



STEEL STRUCTURE
BEARING PAD

LONGITUDINAL SECTIONS
BLOCKING DIAGRAM

Longitudinal Diagrams



ELEVATION OF LONGITUDINAL STEEL DIAGRAM

Note:
The typical elevation shown above should be detailed on the plans for all steel structures that are on vertical curve grades.

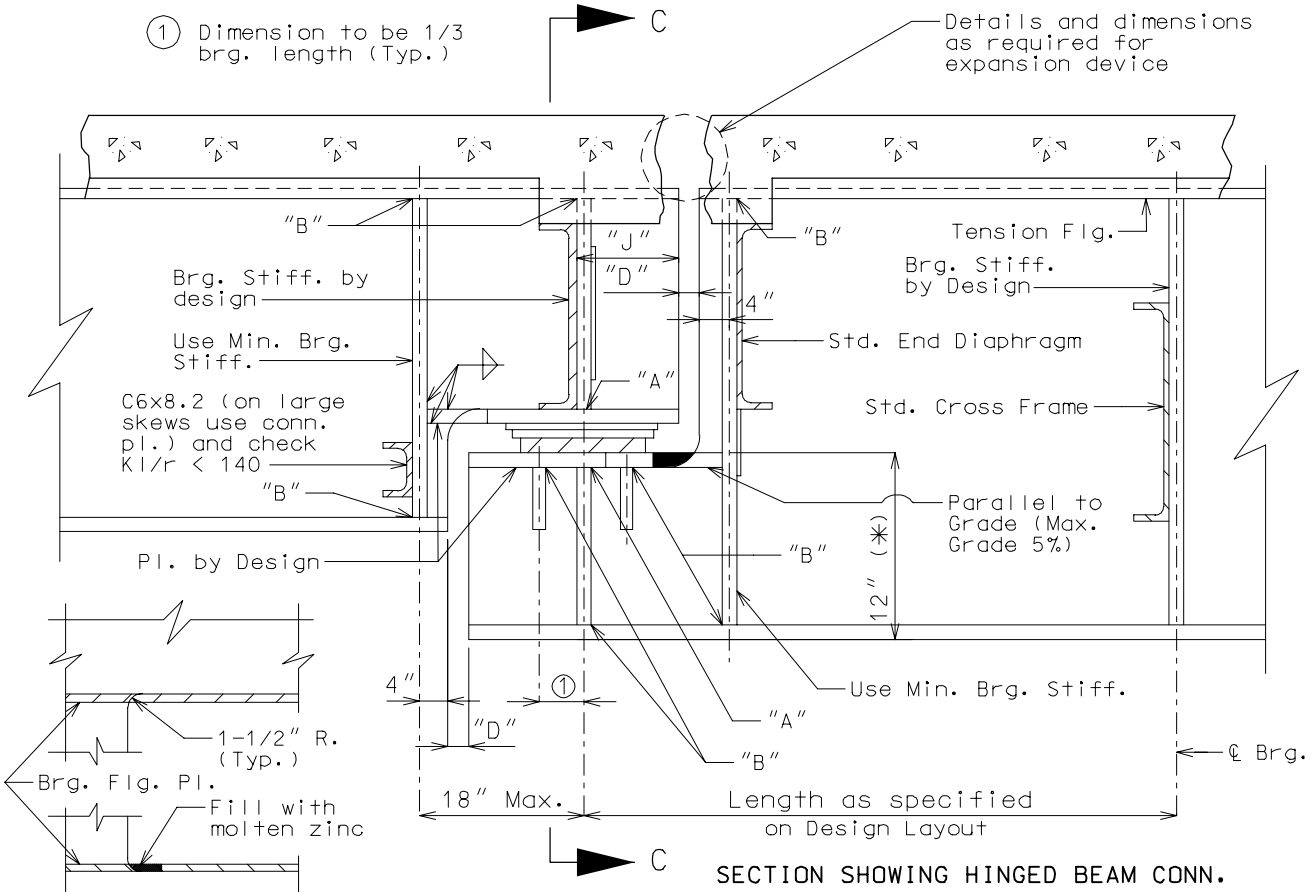
See Bridge Manual Section 4-H for the appropriate notes to be placed on the bridge plans.

(1) Longitudinal dimensions are horizontal from ℄ Brg. to ℄ Brg.

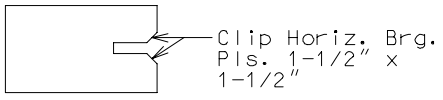
(*) Horizontal dimensions.

BLOCKING DIAGRAM SHOULD NOT BE USED FOR CAMBERED GIRDERS.

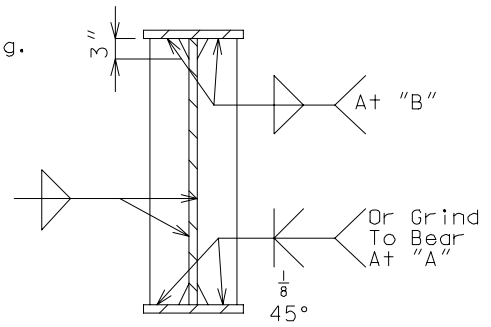
TYPICAL DETAILS OF "HINGED" CONNECTION



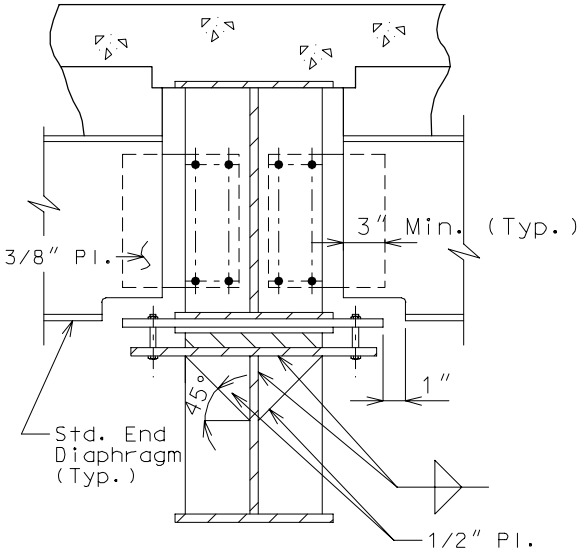
DETAIL OF WEB AT RADIUS TRANSITION



PLAN OF BRG. PLATE



TYPICAL WELDING DETAILS FOR STIFF. PLATES



SECTION C-C

"D" - Gap as required for expansion (3" Min.)
"J" - 5" for bearing with 3" web thickness. Use 6" for all others.

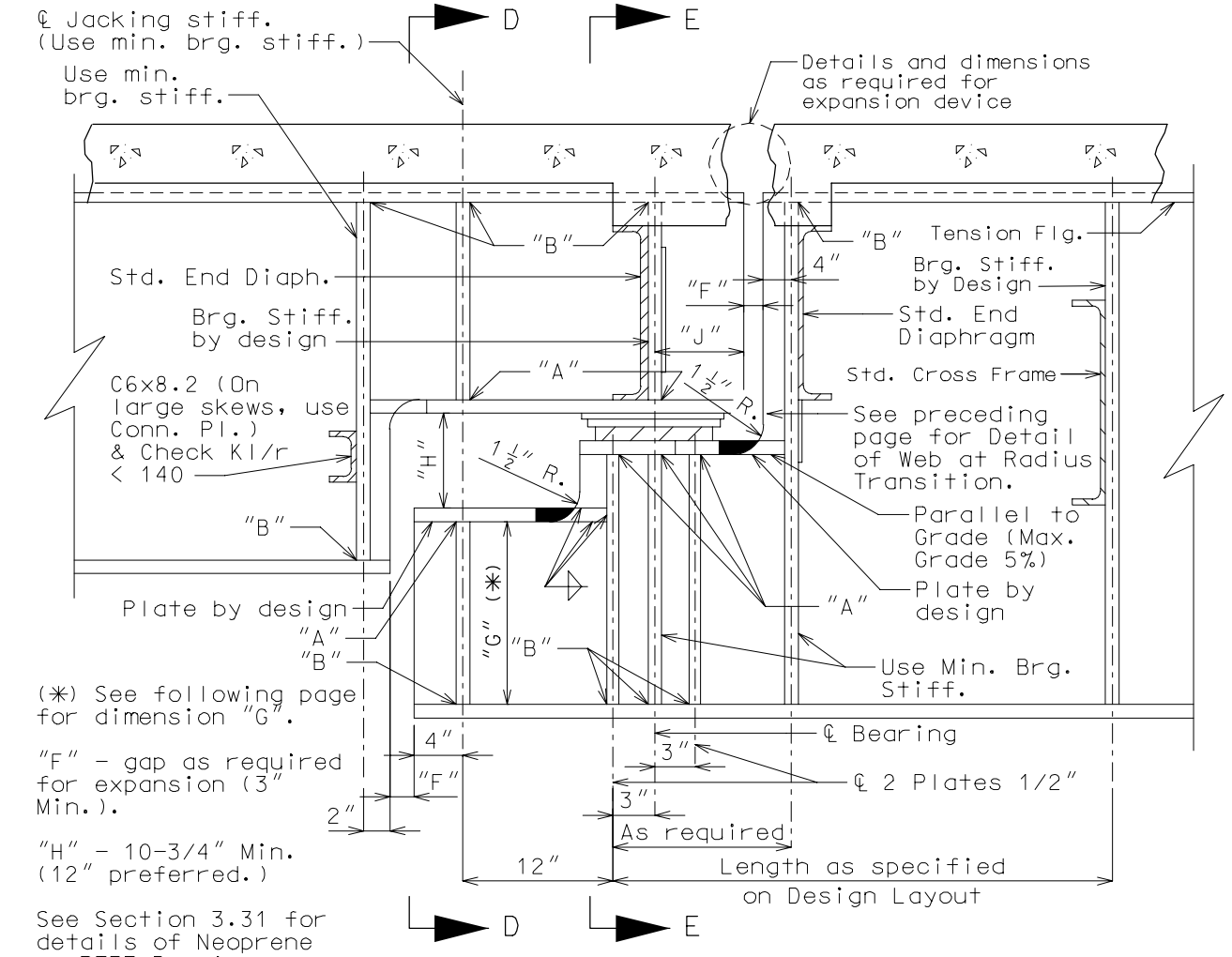
(*) To be used unless greater depth is required by design.

Note: Web thickness and size of fillet weld connecting bearing stiffener plate to web as required by design.

Plans for bridges on a grade or vertical curve shall have the conn. detailed in relation to the slope of the girders and stringers.

See Section 3.31 for details of Neoprene or PTFE Bearings.

TYPICAL DETAILS OF "HINGED" CONNECTION (CONT.)



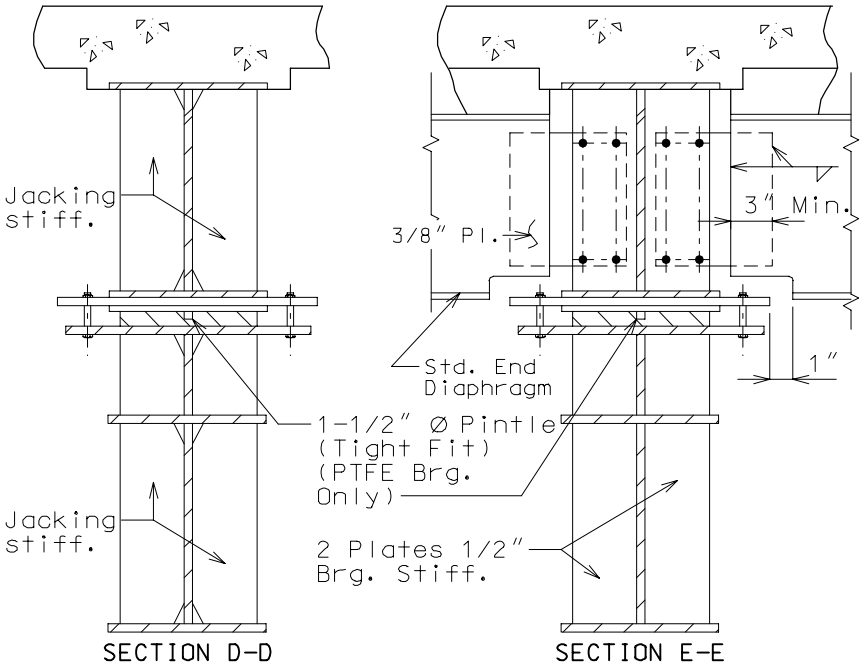
(*) See following page for dimension "G".

"F" - gap as required for expansion (3" Min.).

"H" - 10-3/4" Min. (12" preferred.)

See Section 3.31 for details of Neoprene or PTFE Bearing.

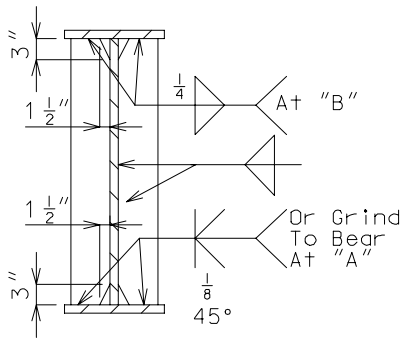
SECTION SHOWING HINGED BEAM CONN.



SECTION D-D SECTION E-E

All dimensions shown are minimum, increase, as necessary.

"J" = 5" for bearing with 3" web thickness. Use 6" for all others.



TYPICAL WELDING DETAILS FOR STIFF. PLATES

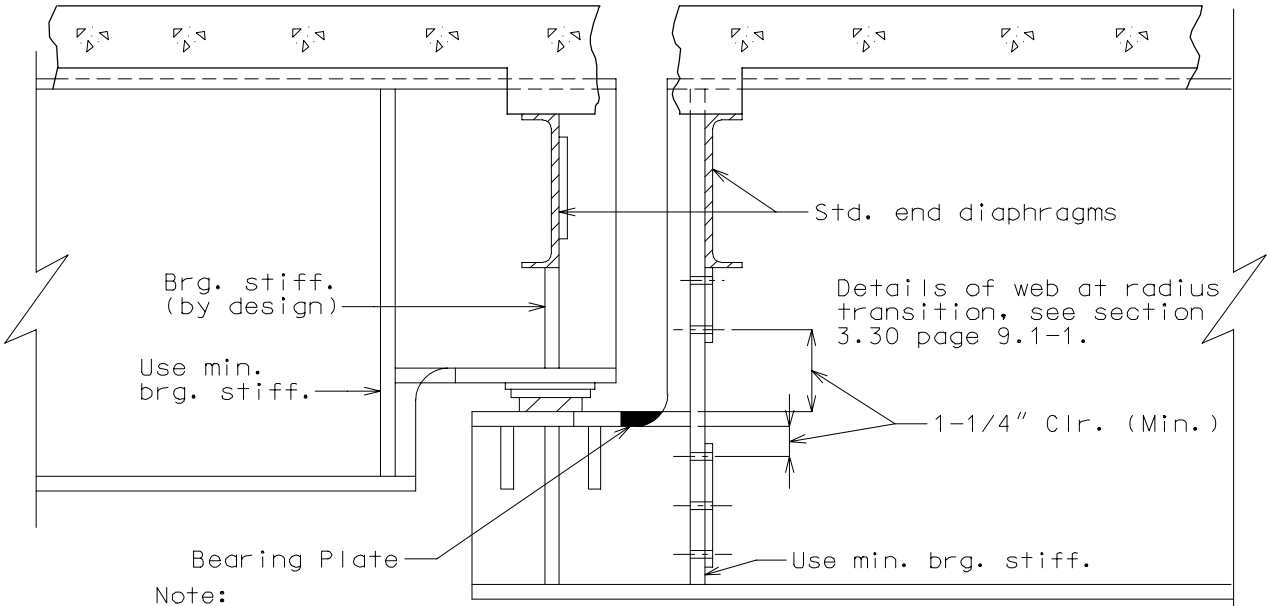
TYPICAL DETAILS OF "HINGED" CONNECTION (CONT.)

ALLOWABLE DEAD LOAD REACTIONS FOR VARIOUS DEPTHS OF "G"
(See preceding page for "G")

WEB THICKNESS	DEPTH "G"	(*) ALLOWABLE DEAD LOAD REACTIONS, KIPS (AT 150 % OVERSTRESS)	WEB THICKNESS	DEPTH "G"	(*) ALLOWABLE DEAD LOAD REACTIONS, KIPS (AT 150 % OVERSTRESS)
5/16"	8"	45.0	7/16"	8"	63.0
5/16"	9"	50.6	7/16"	9"	70.8
5/16"	10"	56.2	7/16"	10"	78.7
5/16"	11"	61.8	7/16"	11"	86.6
5/16"	12"	67.5	7/16"	12"	94.5
5/16"	13"	73.1	7/16"	13"	102.3
5/16"	14"	78.8	7/16"	14"	110.2
5/16"	15"	84.3	7/16"	15"	118.1
3/8"	8"	54.0	1/2"	8"	72.0
3/8"	9"	60.7	1/2"	9"	81.0
3/8"	10"	67.5	1/2"	10"	90.0
3/8"	11"	74.2	1/2"	11"	99.0
3/8"	12"	81.0	1/2"	12"	108.0
3/8"	13"	87.7	1/2"	13"	117.0
3/8"	14"	94.5	1/2"	14"	126.0
3/8"	15"	101.2	1/2"	15"	135.0

(*) No (Live load + impact) excluded.

TYPICAL DETAILS OF "HINGED" CONNECTION (CONT.)



Note:
For details and dimensions not shown, see Section 3.42.
See Section 3.31 for details of Neoprene or PTFE Bearings.

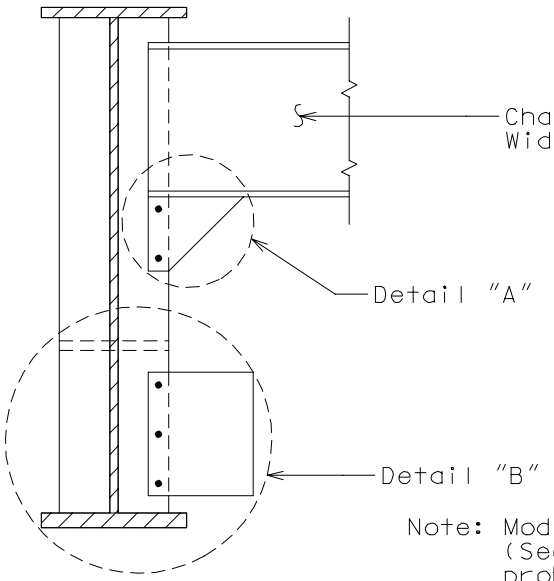


PLATE GIRDER 42" THRU 46". ALSO, 48" AND OVER

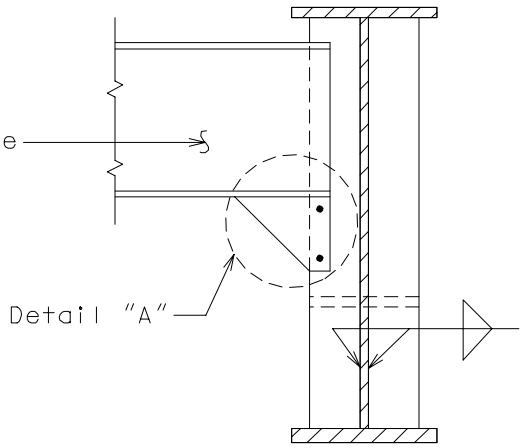
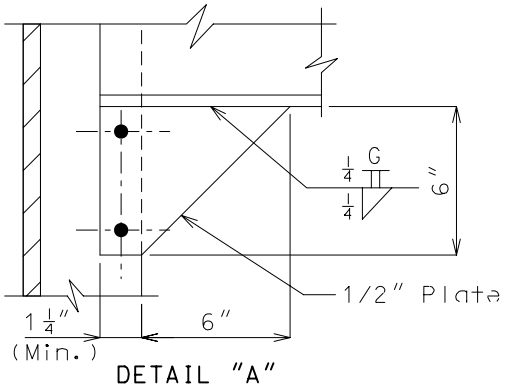
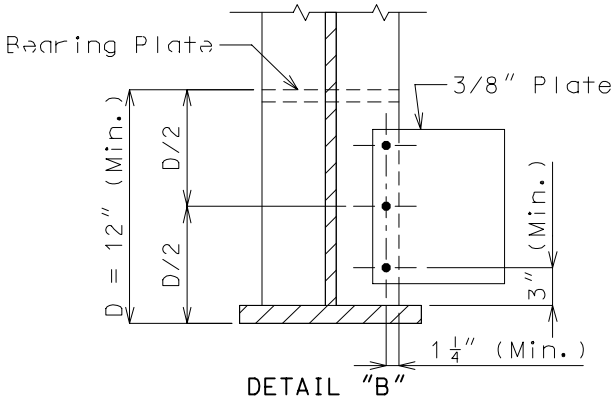


PLATE GIRDER 36" THRU 40"

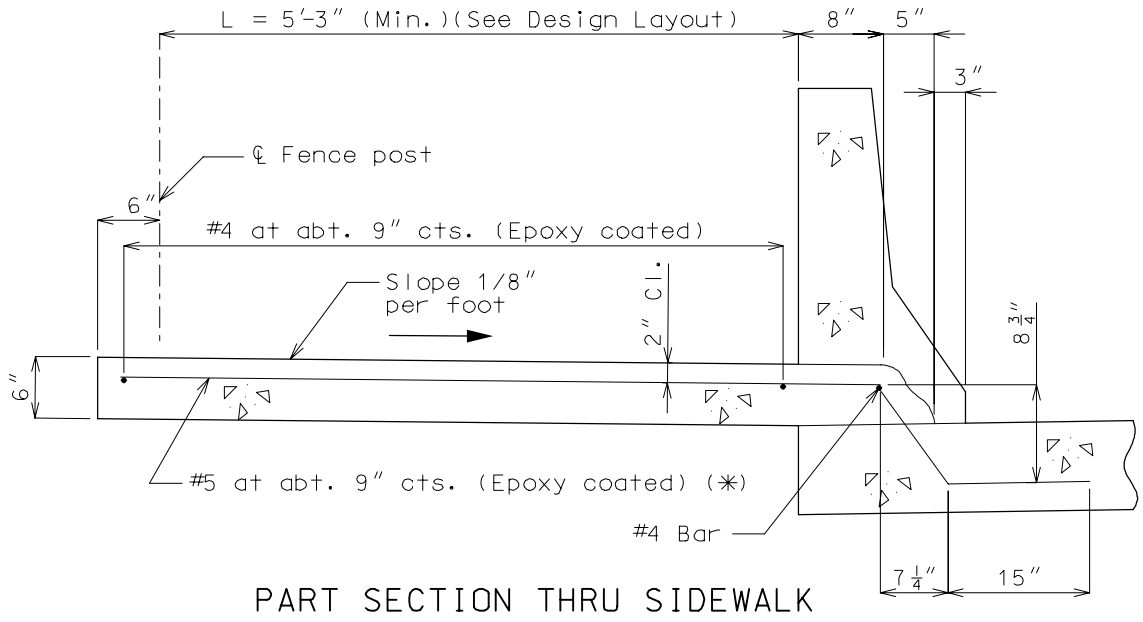
Note: Modify standard end diaphragm connections (Section 3.42), as shown below, if clearance problems exist between bearing plate and end diaphragm connection bolts.



DETAIL "A"



DETAIL "B"



PART SECTION THRU SIDEWALK

(✳) Based on length L = 5'-3".